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TWELFTH ANNUAL REPORT

OF THE

STATE GEOLOGIST

FOR THE YEAR 1892.

TRANSMITTED TO THE LEGISLATURE JANUARY, 1893.

ALBANY:
JAMES B. LYON, STATE PRINTER.
1893.

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With the compliments of

James Hall,

State Geologist.

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STATE OF NEW YORK.

No. 40.

IN SENATE,

JANUARY, 1893.

ANNUAL REPORT

OF THE

STATE GEOLOGIST.

OFFICE OF THE STATE GEOLOGIST,
ALBANY, *January*, 1893.

To the Legislature of the State of New York:

In pursuance of chapter 247 of the Laws of 1888, I have the honor to transmit to the Legislature the Twelfth Annual Report of the State Geologist for the year 1892.

Very respectfully.

JAMES HALL,

State Geologist.

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REPORT.

To the Honorable the Legislature of the State of New York:

During the past year as in the preceding years the time of the State Geologist has been largely devoted to the Palæontology of the State of New York, in the selection and preparation of material and general supervision of the work of drawing, lithographing, printing, etc., and in the preparation of material for the annual reports.

During the past year increased duties have been imposed by the passage of a law authorizing the completion of the work on Palæontology, volume VIII, parts 1 and 2, and for the preparation of a geological map of the State, as well as for completing the work upon the Livonia salt shaft; each one of these requiring more or less time of the State Geologist.

After the passage of the law, Chapter 170 of the Laws of 1892 March 21st, work was resumed upon the printing of the Palæontology, volume VIII, part 1, and the volume was issued in July. At a later period the full edition of 3,000 copies was delivered to the custody of the Secretary of the Regents. Since that time work has been continued upon part 2 of volume VIII, and both the manuscript and the plates are in a forward state of preparation, as will be seen by reference under the head of volume VIII.

The work upon the annual report of the State Geologist has been steadily going on in the preparation of text and material for illustration. It is very unfortunate that the reports of last year can not be placed before you in their printed form at this time, but owing to the destruction of the State printing office by fire in September last, the work remains as it was delivered to that office last winter — fortunately the manuscript of the reports of the Museum staff was stored in the vault and escaped injury.

I am informed that owing to the great destruction of printed matter at that time in the office of the State Printer, which it will be necessary to replace, that the work upon the Museum reports of last year can not be taken up for some months to come. It is likely therefore that still greater delay will occur in commencing the printing our reports, and the report of this year will be still further delayed than usual.

The preliminary work in preparation for the engraving of the geological map involved a journey to Washington and another to New York and Philadelphia which occupied a considerable time, but which, through the earnest and persistent efforts of Mr. McGee of the United States Geological Survey, proved successful, and the Regents have in their possession a contract with Messrs. Evan & Bartles of Washington for the engraving of the base for the geological map, and a proposition from Major Powell, Director of the Survey, to furnish, without cost to the State, the color plates. Proof sheets of one half the base map have been received from Washington during the month of November, and proofs of the remaining portions of the State are promised very soon, and will undoubtedly be in hand before the end of the present year. The field work upon the geological map began in early June, and a portion of the State in the Oneonta district was carefully examined by Mr. Darton of the United States Geological Survey, who was joined by the State Geologist towards the conclusion of his work in a final review of the region examined. The result of t' is work has been the confirmation of certain views relating to ' ' relations of the Oneonta sandstone, Chemung group, and Catskill group proper, which had been published by the wr many years ago, but which it seemed desirable to review confirm by fuller examination before the final publication of geological map of the State. The details of this work will ap r further on, accompanied by a map of the region.

The greater part of the autumn, from early September to e middle of November, has been given to field work conn d with the geological map and the Livonia salt shaft. It wa n- sidered very important that the Helderberg escarpment, v n forms such a conspicuous feature in the eastern part of the te from Cherry Valley eastward to Coeymans and southwa to Rondout, should be carefully examined and the limits o ne

several geological formations constituting the mass accurately laid down upon the map. This work has been accomplished and a careful study of the escarpment made by myself and assistant, Mr. N. H. Darton, first, from Howe's Cave, by way of Schoharie, Berne, Knox, the Indian Ladder, etc., to Clarksville. Along this line of observation the rocks of the Lower Helderberg, together with the representatives of the Niagara and Clinton groups, with the waterlime at their base, rest in apparent conformity upon the rocks of the Hudson River group below, which are themselves undisturbed along the eastern and western line to the outcrops and dip gently to the southward between the limits above indicated. The first indication of a disturbance occurs to the north, and northwest of Clarksville, where, following the main line of the escarpment, the rocks of Helderberg dip beneath the surface of the valley, while the base of the formation diverges to the northwestward, ending in a broad promontory known as Stony Hill, leaving a deep indenture suggestive of a partial faulting of the strata along this line of deep erosion. This outlying area has often been taken for a circumscribed outlier of these formations, and on cursory examination presents that aspect. Following the line of outcrop southeasterly from its exposure on Stony Hill the escarpment, which is there obscured by a great accumulation of drift material upon its northern face, gradually becomes conspicuous, and before reaching South Bethlehem, and at that place, also farther to the southeast, this escarpment reaches its greatest elevation and acquires its boldest features. It is in the neighborhood of South Bethlehem also that we first find evidence of the unconformity of the Helderberg rocks and the Hudson River shales where the latter present evidence of having been uplifted, folded or contorted before the superincumbent limestones were deposited. One interesting example in the bank of a small creek presents an exposure of the shales and limestone which shows that the lower beds of the latter, corresponding to the Tentaculite layers of the Lower Helderberg, are infolded with the slate, apparently due to an overthrust fault; the entire exposure presenting the strongest evidence of unconformity.

From the neighborhood of Coeymans to the southward the escarpment of the Lower Helderberg rocks is not so continuous or conspicuous, being interrupted in many places by deep ravines and obscured also by elevations of the Hudson River group, which appear in more or less continuous, or frequently interrupted ridges, and not unfrequently isolated hills, in front of the great escarpment.

In the neighborhood of Catskill, along the Catskill creek, the Lower Helderberg escarpment of Pentamerus limestone, with its associated beds of Waterlime, forms a strong vertical escarpment, while the bed of the creek presents the Hudson River shales extremely folded and lying in almost vertical position.

In the neighborhood of Catskill and Rondout so much excellent work has been done by Prof. William M. Davis, of Cambridge, that it can be safely adopted for use in laying down the geology of that region upon our map, and, in consequence of this, much time was saved in our investigations.

To the southward of Rondout, although these limestones hold their place and even present strong continuous escarpments, they are so much broken and disconnected that they can not be followed with the same facility as to the northward and westward from Catskill.

At Rosendale we find the most southern exposure of these high escarpments of the Lower Helderberg limestones underlaid by a great development of the Waterlime which is here extensively manufactured into hydraulic cement. In the bed and banks of the creek at this place the geological formations are exposed from the Hudson river shales upwards to the Lower Helderberg limestones, and there are certain layers of red and greenish marl and sandstone which apparently represent the Medina sandstone and Clinton group. This is the first exposure observed after leaving Howe's Cave where we have evidence of the presence of any beds representing the Medina sandstone and Clinton group in the lower part of the great escarpment. At Howe's Cave we have an exposure of about thirty feet of shale below the Niagara or Coralline limestone which represents the Clinton group in that locality. At this place the pyritiferous

shales of the Clinton group rest directly upon the upper arenaceous-shaly beds of the Hudson River group.

Returning to the neighborhood of Howe's Cave the work on the escarpment was again taken up and continued in a westerly direction. The gradual thinning of the Lower Helderberg mass diminishes the strong feature of the escarpment; the Oriskany sandstone gradually ceases to be a prominent feature and the gradual thinning and final disappearance of the Cauda-galli grit brings the Upper Helderberg limestone into close proximity and final contact with the lower mass, thus becoming the most prominent feature in the escarpment as we go westward. In the earlier general observations and publications upon the geology of New York this condition was not understood, and the great mass of the Lower Helderberg, so prominent along the Hudson river from Rondout north and thence northwest to Schoharie was regarded as the same limestone terrace which extended to Black Rock on the Niagara river. Even more extreme was the opinion published, identifying the great Helderberg terrace and escarpment with the Niagara Falls escarpment. This generalization came from the want of a knowledge of the elements composing this escarpment at any point, and therefore the bolder features only entered into the result. It should be remembered also that this conclusion was reached without any knowledge of the fossil contents of these strata which at that period were little known and not regarded as a necessary element in geologic generalizations.

The elements entering into this escarpment in different points in its extension are somewhat variable. In Schoharie and Albany county are at its base, the Hudson River group either in its horizontal or disturbed condition is succeeded by the representatives of the Clinton, Niagara, Waterlime and the Lower Helderberg mass made up by the Tentaculite limestone, the Pentamerus limestone, Shaly limestone, Upper Pentamerus limestone, or Scutella (Becraft) limestone.

[The report is incomplete at this point for want of illustrative sections and map which will appear in next report.]

However in continuing our investigations to the westward we have proved that the Lower Helderberg limestones in their lower members maintain a greater thickness and are more persistent than we have usually believed. It was formerly supposed

from the observations of Mr. Vanuxem that the Lower Helderberg group had its western termination about the longitude of Auburn or the eastern shore of Cayuga Lake, and it is in this neighborhood that Prof. S. G. Williams has shown that the lower members of the group do mingle, and alternate with the Waterlime and the marls of the upper portions of the salt group. At numerous localities similar conditions may be observed where the magnesian sediments of the Waterlime and associated marls have encroached upon the sea bottom in which the lower Helderberg limestone were being deposited and the sediments of these two formations have become mingled or alternated in deposition. At Howe's Cave, Schoharie and other places it is not uncommon to see the dark blue Tentaculite limestone in layers of one-quarter or one-half an inch in thickness alternating with the drab colored Waterlime in laminæ of equal thickness. This alternation continues through several feet of thickness, the blue Tentaculite layers gradually growing thicker and the drab Waterlime proportionally thinner till these beds of passage are passed and we have the Tentaculite limestone gradually passing into thick heavy bedded layers of dark blue limestone, which on polishing becomes a fine black marble. In going farther westward this distinct alternation of beds is not so marked, but instead a gradual mingling of the two sediments while in process of deposition.

In going westward from Cayuga Lake outcrops of the Lower Helderberg have rarely been found showing satisfactory evidences of the age by the presence of fossils through the beds many years ago doubtfully referred to this horizon in Ontario county have proved to be part of the formation. Later evidences coming from the well borings and especially from the excavations of the Livonia salt shaft have shown that the lower members of the Helderberg limestone with its fauna represented in a few of the characteristic fossils extend much further to the westward than we had heretofore supposed.

The results in detail of this geological exploration will be communicated together with the portions of the map in which the limits and extent of the geological formations explored will be laid down.

The collections made at the Livonia salt shaft by Mr. D. D. Luther show very clearly the extension of the Lower Helderberg fauna to that longitude, but thus far no fossils of that age have been found in the material of that horizon brought out from the salt shafts on the west side of the Genesee River. As the natural result of the intermingling of an increased proportion of the argillo-magnesian sediments of the Waterlime epoch with the nearly pure calcareous sediments constituting the fossiliferous Lower Helderberg group the ocean waters became unfit for the support of those forms of life which so abundantly characterize the different members of that group in its more easterly exposures. It is no doubt true that the sediments of that age do extend farther to the westward, but their individuality is lost, the impure magnesian sediment prevailing over the calcareous material of eastern origin, the whole mass becoming of a dirty gray color and quite unfit for the support of life in any kind of organism except perhaps a few seaweeds, or other obscure organic manifestations.

It is in only those parts of the Waterlime group = Rosendale limestone, where these turbid sediments are not deposited, that the characteristicts fauna of that horizon, the Eurypteridæ, flourish, and fossils of this kind are extremely rare, or altogether wanting in the central portion of the State.

The maps, sections and reports of myself and Mr. Darton, assistant geologist, which were originally communicated with this report have been withdrawn since they could not be engraved in time for publication. These will be incorporated with the work of 1893, and be published with the work of the same year.

The report on the Livonia salt shaft, so far as the work had progressed, was also communicated with the present report, but the delay in printing has given time for completing the work upon the shaft and the later observations will be combined with the earlier, making a single report upon the results obtained during the two years of observation, and the collection of material from the several geological formations passed through in the progress of the work. This paper, with its maps, sections of salt wells, etc., will be communicated with the report of the State Geologist for 1893.

PALÆONTOLOGY OF NEW YORK.

VOLUME VIII, PART I.

This volume was issued from the press of Charles Van Benthuysen & Sons in July, 1892, and has met with an appreciative and cordial reception from students of Palæontology and Geology everywhere. As indicated by its title it purports to be "An Introduction of the Study of the Genera of the Palæozoic Brachiopoda," and its scope is therefore somewhat broader than that of previous volumes of this series, which had to deal mainly with the presentation of the various palæozoic faunas of New York in their order of geological sequence or in their biological relations. The work contains xvi — 367 pages of text, accompanied by 42 lithographic and 2 photolithographic plates. The purpose of the work is to give accurate diagnosis and illustrations of each genus with extended bibliography and synonymy, and various observations on structure, affinities and distribution.

The history and plan of the work are set forth in the following manner in the preface:

The completion of the present volume is a partial fulfillment of a promise made at the close of Volume IV of the Palæontology of New York, in 1867. The work is presented to the student with a hope that it may prove a useful contribution to science and a helpful guide in the study of that most abundant and most important class of Palæozoic fossils, the Brachiopoda. Originally intended to form a supplementary part of Volume IV, the subject has expanded to such an extent that two volumes will be required to present the results with a reasonable degree of completeness; and even with this addition some very important matter, as the microscopic shell structure, originally intended for the work, will have to be omitted from these volumes.

The study of the Brachiopoda made necessary in the preparation of Volumes III and IV, and more especially in the latter,

had shown the necessity of subdividing many of the older recognized genera, which had become the receptacle for forms having external similarity to the typical members of the several groups, but possessing quite dissimilar internal structure. The natural disinclination to propose new generic terms for members of a class of fossils which had been so widely and thoroughly studied in Europe, operated as a restriction in the erection of new names. However, it became necessary to describe in those volumes and in cotemporary papers some thirty-one new generic forms and to suggest the necessity for farther separation among the heterogenous assemblages. These studies, made with fairly good collections, and ranging through the Silurian and Devonian faunas, could not fail to attract attention to the different external aspects and interior characters of forms known under the same generic terms, and considered as distributed through all the Palæozoic formations. Although the genera thus far proposed had not been based upon a recognition of their appearance and duration in geological time, yet the student could not fail to discover evidences of organic change in this direction. While discussing certain generic and specific forms as characterizing known geological horizons or certain groups of strata, we had not yet taken into consideration the fact that modifications of organic types had been coincident with every change, or progress in geological time. The great law of progress through long intervals had been everywhere recognized in geological science, but just how or in what manner these changes had supervened had rarely been shown in detail. Certain fossil genera have long since been recognized as Silurian, some as Devonian, and others as Carboniferous, but these are never entirely restricted to the formations which they are said to characterize. They have all doubtless been derived from some remote progenitors, and at certain horizons, or throughout certain formations have become so abundant and so fully developed, that they are said to characterize that stage or formation. The most abundant and extravagant forms among fossil organisms can usually be traced to some parent stock of more modest pretensions, and in their early appearance, represented by few individuals.

As stated, the studies of the Brachiopoda to the close of Volume IV of the Palæontology had shown the importance of

some investigation which should deal directly with these questions. And moreover the science demanded the results of such an investigation in aid of its future progress.

The original conception and plan of the work which the author had proposed to himself was a very simple one, viz.: to select the earliest representative of a genus in any of the geological formations and to follow it through all its manifestations and modifications in geological time, to its final disappearance; or so far as these modifications should appear in the Palæozoic rocks, to which he had limited his research.* With the knowledge then possessed and with the collections at his disposal he had supposed that the result of such an investigation could be embraced in a supplementary part to Volume IV, and under this title the work was announced. This study was commenced very soon after the publication of that volume and its general plan was carried out so far as the lithographing of about thirty plates, when the farther progress of the work was suspended, to be resumed only in the latter part of 1888.

In the meantime the duties of the author had separated him almost entirely from this work, and owing to changes, over which he had no control, in the organization and management of the State Museum, the collections which he had planned to make for use in its preparation had not been made. The progress in our current knowledge of the subject, and that recorded in the publication of volumes and miscellaneous papers during more than twenty years had been enormous, and the undertaking which had been deemed feasible in 1867, seemed almost beyond attainment in 1888. The work was resumed however, with no other collections immediately available for use, than those upon which it had been commenced. In the original plan four plates were left for the illustration of the Inarticulata; the present volume furnishes ten additional plates, and the illustration of these forms may be regarded as fairly complete, according to our present knowledge.

The plates which were lithographed at the commencement of the work are designated on the upper left-hand margin as

*The difficulty of procuring sufficiently abundant and characteristic collections of the later formations was in itself a sufficient barrier, and the scope of the work did not contemplate the discussion of Mesozoic and later genera, except in an incidental manner.

"Volume IV, Part II." Those lithographed since 1888 are designated as Volume VIII, and while the illustrations of the first named plates are not always arranged as would have been done with later knowledge and more abundant material, it is hoped that the intercalation of the new plates may not seriously interfere with the proper connection and continuity of the work, or with the facility of reference so important to the student. Although the final numbering is XX, the actual number of plates in the volume is forty-two.

The printing of this volume had been completed to the end of the Inarticulata, page 183, in March, 1890, when further progress was suspended, from causes over which the author had no control. The printing was resumed in the autumn of 1890, and the book was in type to page 304 in February, 1891, when its progress was again suspended to be resumed only in April, 1892. This delay in publication, which has not in any way been due to the author, requires an apology to the scientific public; and those authors who may have published papers relating to the Brachiopoda, during 1890 or 1891 which could not be cited in this volume, will here find the explanation.

At the time this work was commenced the earliest known articulate Brachiopod had been described under the name of ORTHIS, and without having the knowledge or means to verify or disprove the character of this fossil, the genus ORTHIS was adopted for the basis of discussion. Had these older forms been better known, the order of the work might have been somewhat modified. The other associated and succeeding genera have been taken up and treated after the same idea as in ORTHIS; limiting the discussion to those which seem to be a natural result of the modification of certain essential organic features characterizing the earliest forms of the orthoid type.

Following this order and method we pass through all the ORTHIDÆ, the strophemenoid and streptorhynchoid forms in their varied aspect and modification, and through the leptænoid forms to CHONETES and the PRODUCTIDÆ proper, with which the series seems naturally to end.

All the spire-bearing forms, all the RHYNCHONELLIDÆ and PENTAMERIDÆ as well as the terebratuloid forms have been left out of consideration in the present volume, believing that a more

natural and useful classification will be found in the present adopted order and arrangement of the genera. Chapters upon the classification and broader relations of the genera are given at the conclusion of the two principal divisions of the work. The succeeding part ii of volume VIII will embrace the discussion of the genera under the several groups just mentioned, and they will be treated essentially in the same manner as in the present volume. The work on the second part is already far advanced; a large amount of material has been accumulated for study; thirty-six plates have been lithographed, a considerable number of drawings have been made and a large amount of manuscript has been prepared.

During the interval of more than twenty years from its commencement, great progress has been made in the study of both genera and species of the Brachiopoda. The late THOMAS DAVIDSON, LL. D., of Brighton, whose life had been devoted to the study of these organisms, living and extinct, made important contributions to our knowledge up to the time of his death in 1885. Essays toward the structure and classification of the genera were made by ZITTEL, ŒHLERT and WAAGEN, and communications of no little importance relating to structural characters of genera and species, appeared from all quarters of the scientific world.

The multiplicity of these communications is indicated in part by the bibliographic tables presented in this volume; they also show the wide-spread interest in the Brachiopoda, not only among students of biology, in their structure, morphology and taxonomy, but among geologists, in their value as stratigraphical indices. American students have heretofore labored under a disadvantage in the irregular diffusion of the literature of the Brachiopoda. Much of the European literature is inaccessible except to those working in the vicinity of extensive libraries; the American literature is so scattered through scientific periodicals, proceedings of various societies, etc., as to be frequently inaccessible. Furthermore, while the more general treatises of ZITTEL and ŒHLERT may be in the hands of many, the greatest of all works upon the subject, that of THOMAS DAVIDSON, is beyond the reach of but a very few.

With this volume, therefore, is presented, especially to American students, the first part of "An Introduction to the Study of

the Genera of the Palæozoic Brachiopoda," a work not conceived upon the plan of any of its predecessors, but designed to set before the student the present condition of our knowledge of these genera, with such discussions and illustration as will serve most to clearly indicate what progress has been made in our knowledge of these organisms and in what directions much still remains to be done.

In the preparation of this work every effort has been made to bring under close and careful scrutiny all obtainable material representing the Brachiopoda. The collections of no single institution or individual could furnish the specimens requisite for this undertaking, and recourse has been had to all sources of material within reach. The collections of private individuals as well as of public institutions have been placed at the disposal of the work, and but for such aid it could not have been presented in a creditable form.

In the body of the work all the palæozoic genera of the Inarticulate Brachipoda are discussed, and of the Articulate genera, the Orthoids, Strophomenoids, Leptænoids and Productoids. The remaining Articulate genera will be considered in the second part of this work. The following list of titles, with reference to the pages of the volume, will indicate the subject-matter. In this list, names of subgeneric value are inset under their proper capital, and undoubted synonyms are in italics.

* This genus has been erected since the first part of this volume was printed.

During the progress of the work it became necessary to introduce descriptions of a considerable number of hitherto undescribed species, which were needed in order to give completeness to the generic discussions and illustrations. These descriptions are included in supplements; one at the completion of the discussions of the Inarticulate Brachiopods, and the other at the close of the book.

The species there described for the first time are:

PALÆONTOLOGY OF NEW YORK.

VOLUME VIII, PART II.

This volume will open with the discussion of the spire-bearing genera of the Palæozoic Brachiopoda, and will include a notice of all genera not mentioned in part 1 of this work. The study of the spire bearing Brachiopods involves much painstaking and careful mechanical manipulation for the accurate demonstration of their critical characters. The utmost caution is necessary in the discrimination between the *apparent* and the *actual* structure of the delicate internal spiral supports, and the investigation of these groups has, therefore, progressed somewhat less rapidly than that of the others. The work, however, is well forwarded, and at the present time 320 type-written pages of manuscript have been prepared, and 70 pages thereof were delivered to the printer on November 9th, 1892.

The accompanying list will show the number of genera covered by the entire manuscript, and indicate such divisions as it is proposed to recognize in the work, including a certain number of new terms which the necessities of the work have required and which are provisionally employed in the form here used.

Spirifer, Sowerby, 1815.
- Delthyris, Dalman, 1828.
- Trigonotreta, Kœnig, 1825.
- Choristites, Fischer, 1825.
- *Fusella*, McCoy, 1844.
- *Brachythyris*, McCoy, 1844.
- Reticularia, McCoy, 1844.
- Martinia, McCoy, 1844.
- Martinopsis, Waagen, 1883.
- Mentzelea, Quenstedt, 1871.
- Cyrtia, Dalman, 1828.

Metaplasia, nov.
Verneuilia, nov.
Cyrtina, Davidson, 1858.
Syringothyris, Winchell, 1863.
Spiriferina, D'Orbigny, 1847.
Ambocœlia, Hall, 1860.
Athyris, McCoy, 1844.
- *Spirigera*, D'Orbigny. 1847.
- *Euthyris*, Quenstedt, 1871.
- Actinoconchus, McCoy, 1844.
- Seminula, McCoy, 1844.
- Cliothyris, King, 1850.
- Spirigerella, Waagen, 1883.

Kayseria, Davidson, 1882.
Merista, Suess, 1881.
- *Camarium*, Hall, 1859.

Meristella, Hall, 1859.

Dicamara, nov.
Charionella, Billings, 1861.
Pentagonia, Cozzens, 1846.
Goniocœlia, Hall, 1861.
Meristina, Hall, 1867.
Whitfieldia, Davidson, 1882.
Whitfieldella, nov.
Camarospira, nov.
Hyattella, nov.
Nucleospira, Hall, 1859.
Retzia, King, 1850.
Eumetria, Hall, 1864.
Hustedia, nov.
Acambona, White, 1862.
Trematospira, Hall, 1857.
Parazyga, nov.
Rhynchospira, Hall, 1859.
Homœospira, nov.
Ptychospira, nov.
Uncinella, Waagen, 1883.
Uncites, Defrance, 1825.
Hindella, Davidson, 1882.
Dayia, Davidson, 1881.
Cyclospira, nov.
Atrypa, Dalman, 1828.
Spirigerina, D'Orbigny, 1847.
Gruenwaldtia, Tschernyschew, 1885.
Karpinskia, Tschernyschew, 1885.
Atrypina, nov.
Zygospira, Hall, 1862.
Catazyga, nov.
Glassia, Davidson, 1882.
Anoplotheca, Sandberger, 1856.
Bifida, Davidson, 1882.
Anazyga, Davidson, 1882.
Coelospira, Hall, 1863.
Leptocoelia, Hall, 1857.
Clintonella, nov.
Rhynchonella, Fischer, 1809.
Protorhychonella, nov.
Orthorhynchula, nov.
Rhynchotrema, Hall, 1860.
Stenoschisma, Conrad, 1839.
Rhynchotetra, Hall, 1879.
Cyclothyrella, nov.
Camarotoechia, nov.
Plethorhynchus, nov.
Liorhynchus, Hall, 1860.
Wilsonia (Quenstedt), Kayser.
Uncinulus, Bayle, 1878.
Uncinulina, Bayle, 1878.
Hypothyris (Phillips), King, 1850.
Pugnax, nov.
Eatonia, Hall, 1857.
Terebratuloidea, Waagen, 1883.
Rhynchoporina, Œhlert, 1887.
Rhynchopora, King, 1856.
Camarophoria, King, 1846.
Camarophorella, nov.
Syntrophia, nov.
Camarella, Billings, 1859.
Parastrophia, nov.
Anastrophia, Hall, 1867.
Porambonites, Pander, 1830.
Noetlingia, nov.
Lycophoria, Lahusen, 1885.
Conchidium, Linné, 1760.
Pentamerus, Sowerby, 1813.
Barrandella, nov.
Sieberella, Œhlert, 1887.
Pentamerella, Hall, 1867.
Gypidula, Hall, 1867.
Capellinia, nov.
Branconia, Gagel, 1890.
Clorinda, Barrande, 1879.
Stricklandinia, Billings, 1863.
Amphigenia, Hall, 1867.

The genera remaining for investigation are not numerous and are composed largely of the Terebratuloids. To these are to be added some small groups whose generic relations and broader affinities are somewhat uncertain. The ground to be covered is represented by the following titles:

Stringocephalus, Defrance, 1827.
Terebratula, Müller, 1776.
Dielasma, King, 1859.
Epithyris, King, 1850.
Waldheimia, King, 1850.
Cryptacanthia, White and St. John, 1868.
Hemiptychina, Waagen, 1883.

Centronella, Billings, 1859.
Cryptonella, Hall, 1861.
Scaphiocoelia, Whitfield, 1890.
Hallina, Winchell and Schuchert, 1892.
Rensselaeria, Hall, 1859.
Megalanteris, Suess, 1856.
Notothyris, Waagen, 1883.
Eichwaldia, Billings, 1858.
Aulachorhynchus, Dittmar, 1872.
Richthofenia, Kayser, 1883.
Lyttonia, Waagen, 1883.
Oldhamina, Waagen, 1883.
Almadenia, Pohlig, 1892.

Plates. During the years from 1871 to 1881 eleven plates of Spirifers were lithographed and the entire edition printed in preparation for this work. During the progress of the work on volume VIII, part 1, 1889, five additional plates of this group of fossils were lithographed and printed. Besides these we have now twenty-four plates drawn on stone, some of which have been proved, but none are as yet printed. These together make a total of forty plates which may be regarded as finished for the second part of the volume. For the proper illustration of the work about twenty-five more plates will be required, the drawings for which may now be considered as essentially completed.

GEOLOGICAL MAP OF THE STATE.

A geological map of any country or portion of country is of the first importance to its inhabitants. The limits of rock formations where they contain valuable minerals or otherwise is of importance, and in fact there is no rock formation of any considerable extent but has its economic importance in every country which may come under the domination of civilized man. At the outset there is an effort made to learn the limits and distributions of the rock formations and their mineral contents. Early geological maps of any country are necessarily crude. The accuracy of the geological representation must depend upon the degree of perfection of the geographical or topographical maps which may be used as the base for illustrating the geology. We therefore find that not only the geological maps but also all geographical maps of any country, are, in their inception and early stages crude and incorrect, giving only its larger rivers and higher mountains which are the main features of the country, but much is represented from incomplete exploration or given by inference or imagination. As an illustration of this condition our people are at this moment gathering together all the old maps which can be found in any part of the civilized world relating to

America and the explorations of Columbus, and of the early voyagers who followed him. These maps have gradually become more and more unreliable with progress of time; but it is only in modern times that we have had maps constructed upon careful and reliable surveys, this being equally true of geographical and geological maps. It can not be expected that early efforts in producing geological maps will be more accurate than the geographical maps on which the data were recorded. It is not necessary to make an apology for this state of things; it is an absolutely necessary condition, and the geologists of today who criticise the efforts presented on geological maps of half a century ago, should remember that only a small part of our country has yet been surveyed with sufficient accuracy to record the geological data with a degree of exactness which will enable them to withstand the investigations of the next quarter of a century.

The fundamental topographical as well as the geographical features of the country may be represented in a general way upon the ordinary geographical map, and it is only when we attempt to carry this representation of geological features into detail and to note the minor subdivisions of those rocks which form the salient features of the country that we find the necessity of more accurate geographical maps. In the prevailing activity among scientific men, it is not prudent for any man to represent the limits of geological formations otherwise than from the most careful and critical investigations, leaving untouched and uncolored those portions of country he has not examined, or which cannot be examined with present means, or under existing conditions. Both in geography and geology the temptation always comes to extend the area of our knowledge beyond that which we have actually determined by carefully traversing the country. Both the geographer and the geologist labor under the same difficulties and temptations; each one fearing to leave unrepresented and uncolored any portion of country which he has even but cursorily examined. In the present condition of industrial knowledge, where each rock formation may have an economic value, the presentation of a geological map to the public incurs grave responsibilities, and it will be far better to leave uncolored those portions which can not be satisfactorily represented, than to color in its entirety any map of a state or a portion of a state

not critically examined. Moreover, since with ordinary means no one can be absolutely sure of every mile of area, it is far preferable to leave uncolored such portions of the map as are not accurately known. If this could be once generally understood these uncolored portions would represent to the student, areas of country which have not been sufficiently examined to be represented on the map, and that these areas offer opportunities for study and the chances of discovery of new facts. If the community would accept this view of the subject the best geographical map might be colored to indicate the limits of formations as far as accurately known, the other parts being left for investigation, and the results of such investigation published each year, and added to our stock of accurate knowledge by coloring some additional portion of the map. For while it may be said that leaving uncolored some parts of a map is a confession of our ignorance, we may respond that to color every portion of a map is only an attempt to hide our ignorance and a practical deception upon the community.

* * * * * * *

The first geological map of the State of New York ever seen by the writer was one accompanying the geological text-book published by Amos Eaton in 1830. It is needless to say that this was a crude attempt to recognize in the geological formations over the greater part of the State of New York, an identity with the secondary formations of Great Britain and Europe. It is scarcely necessary to say that such a map could be not only of no value to the student on geology but a constant source of misleading.

Upon the organization of the Geological Survey of the State of New York, one of the first objects sought was maps for laying down the limits of the geological formations. At that time there were no accurate maps except of small parts of country, and the best resource was found in Burr's atlas of the state and county maps of the State of New York. There seems to have been no approximately correct geographical map of the state available for the use of the geologists for recording their observations. At the close of the survey a small map was engraved expressly for the use of the geologists in laying down the limits of the geological formations. This map from the

eastern limits of the state adjoining Massachusetts, Connecticut and Vermont to its western extremity was about twenty-eight inches and its extreme limit from north to south along the eastern counties of the state, or from the Canada line to Sandy Hook was two inches less than its extent from east to west, or twenty-six inches. The location of towns, villages, and post offices were doubtless taken from the best maps extant, but these afforded very unsafe guides for locating the outcrops of the geological formations.

However, at the close of the survey the order of sequence among the several formations, with the exception of the crystalline, metamorphic and partially altered rocks of the eastern and northeastern counties of the State, had been determined, and these were laid down upon this map with as much accuracy as the map itself permitted, and this representation has served the purpose of a general guide to the geological structure of the State of New York. This map is still useful in showing the general distribution of the unaltered stratified rocks of the State, but even before it had been published, the geologists having in charge the eastern portion of the State were not so well satisfied with their work that universal agreement could be had upon certain areas of country and no attempt was made to represent the age and relations of certain of the formations on the east side of the Hudson river. The index or legend, and the colors of the area representing the "primary system," were followed by the Potsdam sandstone and thence in regular sequence of the formations from that horizon to the Catskill mountains, or the Catskill group, inclusive. There was no difference in color between the metamorphic rocks of southeastern New York and the older gneisses and granites of the Laurentian area of the Adirondacks in the northeastern part of the State, and of the Highlands of the Hudson River. The metamorphic limestones of the southeastern part of the State, now known to be of older age even than the Potsdam sandstone, were not separated by color from the limestones of the Trenton period and no sandstone older than Potsdam was recognized on the map as published in 1842.

The Catskill group in its western extension was represented as terminating abruptly and the limits between the formations of Chemung and Catskill were considered as trenchant lines, making

no allowance for the gradation from one to the other or the intercalation of any other strata. I have already said that even before the final reports of the State geologists were made, and before the map was completed, each one had discovered within the limits of his own district evidences that the geological structure of the State and the relations of the successive formations had not been fully determined; and even at that time a hope was expressed that the State might recognize the necessity of going on with its work to the completion of a geological map which might be worthy of acceptance by the scientific public and by the people of the State as a guide in the study of its geological formations.

At a later period, 1844, Prof. Emmons published an agricultural and geological map of the State to accompany his agricultural reports. This map was published upon the same base as the original geological map of the State. The coloration was almost precisely the same on all parts of the map west of the Hudson river. From the northern limit of the State and the adjacent part of Vermont, extending along the east side of the Hudson river and crossing to the west side below Rhinebeck, a belt of color was introduced to show the supposed limits of the "Taconic system" of rocks, although no mention of the name is made or any indication in the color legend of the map. The map, however, is fully described on page 361 of volume I of the "Agriculture of New York." A description and discussion of the rocks of the Taconic system and of its individual members occupies chapter five, pages 45–112 of the volume. Since 1844 this map has been the only geological map of the State of New York accessible to the student and to the public.

This "agricultural and geological" map of Dr. Emmons, following so soon after the publication of the State map accompanying the reports of the four geological districts, doubtless prevented any immediate effort to secure the means of preparing and publishing a more accurate geological map of the State.

Since this map has been extensively distributed without any accompanying explanation, it may be well to reproduce in this place the original description of Dr. Emmons from the volume cited above.

DESCRIPTION OF THE GEOLOGICAL MAP ACCOMPANYING THE REPORT OF DR. E. EMMONS.

"This map is a reprint, in the main, of the map which accompanies the first reports. Important additions, however, have been made to it. Parts of Vermont, Massachusetts and Connecticut are now included. In addition to these the range of the Taconic system is colored and made a distinct part of the map. It occupies a belt extending from the Canada line to New Jersey and Tappan bay on the North river, below the Highlands. This system, it will be observed, is divided or split by the primary of the Highlands; the older part passing on the east side intersects the Hudson at Peekskill, and the superior portion passes on the west side and leads off into New Jersey, passing through the county of Orange. The primary rocks of Massachusetts, Vermont and Connecticut, which lie in a position nearly parallel to the Taconic system, are colored with lake, and the Taconic system a drab. By this addition the relative positions of the New York, Taconic and Primary systems of New England are indicated. We may see the great primary nucleus of New England as it disappears beneath the oldest sedimentary rock now known, composing the Taconic system, and the disappearance of the latter beneath the New York system. The New York system continues the superior system until we reach Green bay and the sources of the Menomone river, where the Taconic system once more appears, supporting the lower members of the New York system, and reposing on, and supported by the Primary, as in Massachusetts, Connecticut and Vermont.

"The narrow belt of the Taconic system is a remarkable feature in the geology of this country, it being an immensely thick series, which seems to have been deposited in long and remarkably deep seas that resembled profound clefts in the crust of the earth."

"The different members are not distinguished by colors; the difficulty of locating them with that degree of precision which is required in a map, was considered a sufficient reason for omission. The oldest or inferior member, the gray sandstone or granular quartz, lies upon the primary in the range of Williamstown and Dalton, Massachusetts, and Arlington, Vermont. The Stockbridge limestone forms a belt immediately west, and then

there is a belt of silvery talcose slate, or magnesian slate, beyond which the sparry limestone appears in a distinct range, which may be located with some degree of precision, when it is stated that the tunnel of the Great Western railroad passes through it, which is not far from the line bounding New York and Massachusetts. The members are regarded as the inferior rocks of the Taconic system. Still west of them there is a wide belt of Taconic slates, which contains many subordinate beds of limestone and siliceous slate, and which frequently supports the outliers of the lower members of the New York system. The Taconic system, as a whole, may be regarded lithologically as an immense slate system, with subordinate beds of sandstone and limestone, both of which are more largely developed upon its eastern border adjacent to the Primary system."

"The New York system is colored like the former map, which accompanies the volumes already distributed."

Notwithstanding the published discussions, controversial or otherwise, regarding the Taconic system, which were carried on during many years after this publication, no portion of the area described in the map was ever carefully studied or mapped until within recent years. Prof. Dana, Prof. Dwight, Mr. Ford and Mr. Walcott have contributed to our accurate knowledge of this region; so that at the present time comparatively little remains to be done to complete the work.

During the later years also careful geological work has been carried on in New Jersey and in Pennsylvania, and the results in the former are published in a carefully prepared geological map, while in the latter State the final map is in a forward state towards publication.

In the final discussions among the New York geologists preparatory to the publication of the geological map and their final reports, it was discovered that much remained to be done in determining the relations between certain formations everywhere, and more especially in the eastern part of the State. But as only six months were allowed from the time of closing the field work to the presentation of map and reports there was no time or opportunity for review or revision.

The proposition to recognize, upon the map, the Taconic system proposed by Dr. Emmons, was rejected by Mr. Mather and

Mr. Vanuxem, the latter, however, being willing to recognize a series of conglomerates and crystalline rocks of St. Lawrence, Lewis and Jefferson counties which were clearly below the Potsdam sandstone as a distinct group worthy of recognition. The difficulty of the position and surroundings in being compelled to decide questions when the facts were not of common knowledge to the four geologists, rendered the situation embarrassing; and without the time and means for the staff to visit and review the doubtful or disputed points there seemed no other course left but to sanction the map as published. At this distance of time and with the accumulated knowledge coming from all sides, it is easy to criticise the work done upon the geological map published sixty years ago. This map, however, has served as the basis for later work; and supplemented as it was in 1843 by a geological map of the Middle and Western States, published in the Report of the Fourth District, we have had a fairly good basis for work among the Silurian and Devonian rocks of New York and of the States west to the Mississippi valley. This map of 1843 presented the first attempt at a correlation of the rocks of New York, and the east, with those of the west; traced through a thousand miles in extent by their fossil contents, at a time when not a tithe of these fossils had received names, and most of them were entirely unknown in scientific literature or nomenclature. It was an attempt also to carry the nomenclature of the New York system of rocks into the western States, which later investigations in the same direction, have rendered acceptable, and which have become established in the literature of the geological reports of all these States. Crude and imperfect as such a map must necessarily have been, complied from all sources within reach, not always fully authentic; supplemented and verified by some thousands of miles of travel, it has nevertheless, by the testimony of impartial authority served a very useful purpose to the geologists of later years. Nearly sixty years have passed since its publication, its errors have been pointed out sometimes with acerbity, but almost universally treated with leniency, and the map with commendation, as having served a useful purpose in the infancy of our investigations in the Palæozoic rocks of North America.

When placed in charge of the work of the Paælontology of the State in 1843, it was natural that I should desire to rectify

any mistakes and misinterpretations of the past by a determination of the fossils of the several formations, and to substantiate the sequence of the formations as proposed in the New York reports by such evidence.

During the earlier examinations of the western portion of the State with the knowledged then possessed, it was naturally inferred that the conglomerates lying upon the hill summits and high grounds of Alleghany, Cattaraugus and Chautauqua counties were of Carboniferous age, and it was only after studying the few fossils found in these strata that they were proved to be of the age of the subjacent Chemung rocks and it was therefore necessary to relegate them to a lower horizon. Therefore the Carboniferous rocks as indicated on the original geological map of the state, except in the case of a small area to the south of the Olean, have been proved to be of the age of the underlying Chemung rocks.

One of the most notable and interesting questions in discussion at the close of the survey, had reference to the Oneonta sandstone and its relations to the Chemung and Catskill groups. In the later discussions upon the subject by the New York State geologists, and in their final meeting to adjust the nomenclature no satisfactory solution of the difficulties surrounding this subject was reached.

The Oneonta and Montrose sandstones of the annual reports of Mr. Vanuxem were in his final report merged in the "Catskill group," and the most characteristic fossil which lies at the base of the Oneonta was designated as *Cypricardites Catskillensis.*

Mr. Mather, in his final report, used the term Catskill Division to include the Montrose and Oneonta sandstones of the annual geological reports and Nos. IX, X, XI and XII of the Pennsylvania geological reports, and gives in great detail an account of the lithological character of the series of strata constituting the the successive terraces of the eastern mountain slope of the Catskills.*

* *Upper members of the Catskill mountain series of Geological Reports for* 1840 *and* 1841. *Montrose sandstone, and Oneonta sandstone of Geological Reports of New York. Old red sandstone, probably, of Europe. Nos.* 9, 10, 11 *and* 12 *of the Pennsylvania Geological Reports. Old red sandstone, No.* 9 *Mr. Conrad's arrangement.* (Geological Report of New York, 1839, p. 62.) Final Report First Geological District, page 299. 1843.

My first examination of the Oneonta region in 1844 disclosed the fact that the Oneonta sandstone, described as lying upon the Chemung group, really rested directly upon the shales of the Hamilton group, and the quarries cited by Vanuxem as containing Chemung fossils really contained only characteristic fossils of the Hamilton group. This erroneous idea of the order of succession had entered into the discussions of the relations of the Hamilton and Chemung groups, and the arenaceous beds of the former group in that region of country had been referred to the age of Chemung group. Farther examination on the hill summit, in the neighborhood of Oneonta, showed very clearly that rocks carrying characteristic Chemung fossils rested directly upon the top of the Oneonta sandstone. In exploring the country further southward and south-eastward, there was found a belt of gray and greenish-gray shale and sandstone carrying Chemung fossils, lying above the Oneonta sandstone, and succeeded above by red marls and gray grits and sandstones which formed a part of the Catskill group in its western extension. Repeated examinations of this region through several years, although cursory in their nature, confirmed these first observations; but it was not until 1870–71 that the country was mapped with anything like accuracy in regard to the relations of these formations. This map, however, was never published, and it remains as a record of the results of field work of 1870, although the work of previous years had been incorporated. Following this period for several years no extended or systematic field work was carried on, and our increasing information was obtained from desultory observations, and the comparison of fossils collected in the region named; but the subject of inquiry was never lost sight of, and scarcely a year passed without adding something to our knowledge or suggesting some new point of inquiry.

In 1880–81 still further progress was made in the investigation of the Oneonta region and the extension of these formations to the east and west. This work, chiefly done by Mr. Andrew Sherwood, under my immediate direction and supervision, confirmed and extended the conclusions reached in 1870, and in previous years. The result of these investigations was recorded upon a post route map of the State, with the following title and legend.

"A preliminary geological map including a part of the Catskill region, the southern part of New York and adjacent parts of Pennsylvania, to show the relations of the Catskill group to the underlying formations of the Chemung group, Oneonta sandstone and portage group; combining all the previous observations with the field work of 1881, by Andrew Sherwood, under the direction of James Hall, State Geologist." This map, like all the preceding records, was never published and still remains in possession of the State Geologist, as a record of field work done and recorded up to the date of 1881. Other maps and portions of maps likewise containing more or less of the records made during all these years remain still in the possession of the State Geologist, and under the present conditions are of no other value than as evidences of progress of work and the dates upon which it was performed.

The following extract from remarks made before the American Institute of Mining Engineers, will give some idea of the progress of the geological map since 1883:

"In 1883 I had combined, upon a small map of the State, the information which we possessed at that time, and communicated the same with my annual report to the Legislature. The report was published in the regular course, but the special appropriation made for the map was vetoed by the Governor.

"Not discouraged by this untoward and unexpected circumstance, work was continued, and every effort made to render the map more complete, preparatory to its communication with the next annual report. I brought together all the information within reach, whether published or unpublished, reviewing and revising, as far as practicable, the work done by myself and assistants in southern and south-eastern New York.

"Up to the autumn of 1884 I had been working alone, and unaided, without any means whatever from the State, to complete the field work, and to bring together the knowledge which we had gained from various sources, and that which I had acquired from my own investigations and from assistants employed on my personal account, with the purpose to embody the whole in a geological map of the State. At this juncture, and having no one to act as cartographer, Major Powell, with characteristic liber-

ality, sent Mr. McGee, the cartographer of the United States Geological Survey, to Albany, and for some weeks we worked together upon the preparation of the map, with the data which had been accumulated, as above stated, and from all other available sources."

As the work progressed, it was found that the base-map previously used was quite inadequate for the purpose of laying down the limits of the geological formations with the necessary degree of accuracy; and a new base was begun and finally constructed under the auspices of the United States Geological Survey off[illegible] and under the supervision of Mr. McGee. Upon this map was laid down the geology of the State so far as accurately or approximately determined. The title of this map is:

PRELIMINARY GEOLOGIC MAP

of

NEW YORK,

Exhibting the Structure of the State so far as known.

Prepared under the Supervision

of

JAMES HALL,

STATE GEOLOGIST,

by

W. J. McGEE.

Scale 1: 300,000.

1885.

To which I have added the following legend:

"Engraved and colored by direction of J. W. Powell, Director of the United States Geological Survey, for the use of the State Geologist of New York, for his report of 1884, being the map referred to in a resolution of the Regents of the University of the State of New York, January 7, 1885, and afterwards communicated to the Legislature in February, 1885, with the annual report of the State Geologist for the year 1884."

This map, in its manuscript form, was brought before the Board of Regents in January, 1885, with the statement that the Director of the United States Geological Survey had offered to

co-operate with the State Geologist of New York in the preparation of a geological map of the State. In response to this proposition of Mayor Powell, the following resolution was passed on January 7, 1885:

"*Resolved*, That the Director of the Museum be authorized to arrange with the Director of the United States Geological Survey to co-operate with him in the work of perfecting a geological map of the State of New York, and that in the meantime the director be authorized to transmit a copy of the map in its present state to the Legislature for publication as a preliminary geological map."

A copy of this map was communicated to the Legislature in February, 1885, with my annual report for 1884; and an appropriation was made for its publication, which shared the fate of the preceding one.

Encouraged by the action of the Regents of the University, Mr. McGee, with the approval of Major Powell, began the preparation of a map more elaborate in character, and upon a larger scale, than that already presented to the regents and to the Legislature. It was distinctly understood that this resolution of co-operation contemplated the appropriation of means for carrying on field-work in portions of the State requiring special attention, before we could consistently make use of this map for laying down the limits of the geological formations. But while money was freely spent for almost everything else, none was ever allowed for the geological map to enable co-operation with the Director of the United States Survey, and I was again thrown upon my own resources. In the meantime, however, the work on the base-map was progressing at Washington, though latterly almost abandoned because of the apparent apathy on the part of the State of New York as to the result.

In 1888 the large base map then in preparation under the direction of the United States Geological Survey, was so far advanced that a photographed sheet of the western half of the map was colored and brought before the museum committee of the Regents of the University, and shown to some members of the Legislature in the hope of securing some action towards the publication of the map, but nothing could be accomplished at that time.

This map was presented with the following title, subject to revision.

PRELIMINARY GEOLOGIC MAP
of
NEW YORK,
Exhibiting the Structure of the State so far as known.
Prepared under the Supervision
of
JAMES HALL,
STATE GEOLOGIST,
by
W. J. McGEE.
Scale, 1:300,000.
1888.

The publication of the final geological reports, together with the two geological maps, one accompanying the reports of the four Geological Districts and the other accompanying the reports on Agriculture by Dr. Emmons, stimulated the public, and especially the agricultural public to the study of the geology of the State, and for a time it seemed likely that investigations in geology and its relations to agriculture would be continued by the State Agricultural Society and by local societies, following the example of Albany and Rensselaer counties of twenty years previous.

The following list of publications relating to geological surveys of counties and parts of the state from 1820 to the present time will give the student a reference to sources of information regarding the earlier geological and agricultural work which may not be current in our more recent publications.

GEOLOGICAL SURVEYS AND MAPS OF PARTS OF THE STATE OF NEW YORK.

1820. Amos Eaton and T. Romeyn Beck. Survey of Albany county. (No map.)
1822. J. H. Steel. Geological structure of Saratoga county. (No map.)
1823. Amos Eaton. Geological and agricultural survey of Rensselaer county. (Profiles.)
1824. Amos Eaton. A geological and agricultural survey of the district adjoining the Erie canal, taken under the direction of S. Van Rensselaer. Part 1, rock formations and geological profile extending from the Atlantic to Lake Erie.

1830. Amos Eaton. A geologic text-book accompanied by a geologic map of the State of New York.
1842. E. Emmons. Geology of New York; report 2d district; map of the county of Jefferson, geological map of Clinton county.
1849. Asa Fitch. Survey of Washington county. (Two maps.)
1851. J. Delafield. Survey of Seneca county. (Map.)
1851. G. Evans. Survey of Madison county.
1852. Ledyard Lincklaen. Survey of Madison county. (Map.)
1853. W. C. Watson. Survey of Essex county. (Maps.)
1860. G. Geddes. Survey of Onondaga county. (Maps.)
1862. G. Denniston. Survey of Steuben county.
1863. G. Denniston. Survey of Orange county.
1884. B. H. Wright. Notes on the geology of Yates county. (Map.)
1885. J. M. Clarke. A brief outline of the geological succession in Ontario county. (Map.)
1885. C. E. Hall. Geological map of Essex county.
1888. E. B. Knapp. Onondaga county.

I communicate herewith the report of Professor John M. Clarke, assistant palæontologist, giving an account of the condition of the collection of fossils in the State Hall, and showing the accessions from various sources; and the work which is going on in the arrangement and distribution of this material to which reference has already been made. The most interesting collection is that made by Mr. D. D. Luther, at the Livonia salt shaft, which will give us the exact horizon and the vertical range of species in a section of the strata measuring nearly 1,500 feet. It is hoped that we may be able to give a very complete account of this collection with illustrations, of at least some of the new species, in the report of 1893. Some steps have already been taken in this direction and unless some unforeseen interference shall occur, the entire report upon the Livonia salt shaft in its physical and faunal aspect will be presented in that report.

The collection sent by Mr. Raymour of Kansas City, Missouri, illustrating the fauna of the formations in the towns of Cass and Waverly, Cass county, Indiana, is a very interesting one, the collection containing numerous representatives of the faunas of the Corniferous and Hamilton horizons without any indication that these formations are separated from each other by a change of lithological character or other conditions. For the sake of geologic science it will be an interesting inquiry to determine whether there may not be a line of separation between the two

faunas as occurs at the falls of the Ohio, and elsewhere in southern Indiana.

In the report of last year Mr. Clarke communicated a list of the original and illustrated typical specimens of the Palæozoic Crustacea of the collections at the State Hall, making a total of 496 specimens, with citations of all publications where such illustrations have appeared, making a very interesting synopsis which can not fail to be useful to the student.

In the present report Mr. Clarke has continued his list of original and illustrated specimens of the Annelida and Cephalopoda, including 203 original specimens and 402 illustrated typical specimens.

It is a great misfortune that for so many years past we have had no draughtsman connected with the museum staff and have been unable to obtain drawings for illustrating our reports except in the special departments where the appropriation covers such expenditure, while outside of that no illustrations can be furnished. It is quite impossible for any scientific organization to progress without the means for the illustration of the scientific work of its staff.

It is to be hoped that our condition may at some time enable us to prepare and publish an illustrated catalogue of all these fossils, together with those which are to be communicated in the future.

In the south room (No. 39) of the building which is occupied by Prof. John M. Clarke, the assistant palæontologist, there are 188 drawers occupied by types and typical specimens which have been used in the preparation of the preceding volumes of the Palæontology. There are 480 drawers occupied by collections now in use in the preparation of work on the Palæontology. A partial catalogue of these collections was communicated with my report of last year; including the Crustacea. The work on the catalogue has been continued and a second portion is communicated with this report. It is intended, as just mentioned, that the work of preparing this catalogue shall be continued during the ensuing year and the result communicated with the next annual report.

It is a great misfortune that, at the outset of this work, it could not have been carried on in some public building where

the gradually accumulating collections of specimens for the Palæontology of the State could be stored or arranged, and where working rooms could have been had for the accommodation of the State Geologist, his draughtsman and assistant.

These conditions, which were not brought about by any action of the State authorities, compelled the State Geologist to erect buildings on his own grounds at his own personal expense, and to arrange in those buildings the material collected for use in the preparation of the work. From the commencement of the work in 1843 to 1856 all the collections of fossils were made at the personal expense of the State Geologist. From and after 1856 provision was made by the Legislature for the collection of specimens in the field, and from this source an enormous amount of material was obtained — material which has greatly expanded the work, and added largely to its value as a contribution to geological science. All the collections thus acquired remained arranged in drawers or otherwise from the commencement of their accumulation till 1886. As the work progressed the types and typical specimens coming from these collections were separated from the mass and kept by themselves, thus remaining in my possession and under my control for thirty years. In 1886 these specimens were removed by order of the Chancellor of the Board of Regents to the State Hall and placed in drawers in a separate room, to which I had no access for two years, and to the drawers containing the specimens I have never had access up to the time of the present writing.

It is a great satisfaction to me that Mr. Clarke has undertaken the task of cataloguing these specimens, with citations of place of publication, locality of the specimens, name of collector and date of collection, which will make the work a valuable book of reference for students in the science. The completion of this work may serve in some measure to set at rest the question as to what has become of the types and typical specimens belonging to the State.

JAMES HALL,
State Geologist.

REPORT

OF THE

ASSISTANT PALÆONTOLOGIST.

1892.

Report of the Assistant Palæontologist.

ALBANY, *December* 1, 1892.

JAMES HALL, LL. D., *State Geologist:*

SIR. — During the past year my time has been largely devoted to the investigations and other work connected with the preparation of the Palæontology of New York, volume VIII, parts 1 and 2, and with the printing of the first of these parts. Your own report contains a detailed statement of what has been accomplished in this direction. It is proper that I should add to the account there given that this work, which involves much laborious and painstaking preparation of specimens to be studied, has contributed directly and largely to the quality of our Museum collections, by bringing into a condition suitable for exhibition or for the studied reserve of the collection, a great number of this abundantly represented group of fossil animals, the Brachiopoda. No attempt has been made during the year to inaugurate any changes in, or make any considerable addition to the exhibition collection in the Geological Hall. All additions to this department are received at the State Hall, where they are studied and, if space permits, placed in drawers; otherwise they are repacked in boxes and stored.

The collection of Lower Silurian fossils purchased in 1890 of the late William P. Rust, of Trenton Falls, has been removed from the drawers which it occupied on the Palæozoic floor of the Geological Hall, and been incorporated with the serial collection of New York fossils in the State Hall, where it has become accessible for study.

Since the completion of the original drawings for the eighth volume of the Palæontology of New York, Mr. Ebenezer Emmons, who had been engaged in that work, has been occupied

in the arrangement and condensation of the serial collection, at the same time making up a number of smaller serial collections for distribution among the educational institutions of the State. This work, if carried to completion, will supply us with a limited number of school collections which can be furnished upon demand, and not by the usual laborious process of having to search through the entire collection for the requisite material. Besides this it will also serve the more important purpose of protecting our reserve collection, which has already in some places been encroached upon. This is a vital consideration in view of the fact that of late years field collections, upon which the department must largely depend for its supply of material for the schools, have been almost entirely suspended, while the demand for these school collections has not decreased.

The most considerable and important addition to the palæontological collections during the year has been the material sent in by Mr. D. D. Luther from the salt-shaft near Livonia Station, Livingston county, N. Y., in pursuance of investigations for which a special appropriation was made by the Legislature of 1892. Of this material we have now received in all about 130 boxes, most of them since the beginning of the fiscal year. This material, mainly composed of fossils from the Hamilton, Marcellus, Corniferous, Oriskany and Waterlime formations, has been unpacked, washed, ticketed, critically reviewed, and finally repacked in boxes as our drawer space is now all occupied. A selection however was made of specimens of especial interest, and these occupying about twenty-five drawers, are now in the south-east room on the top floor of the State Hall. This remarkable collection, made from a single and consecutive section of rocks upward of 1,400 feet in thickness, contains a large amount of high grade material and enriches the Museum with many undescribed and rare species of fossils. The supreme interest in this collection rests upon the evidence it affords in regard to the succession of fossil faunas. Consequently I have spent much time in the careful identification of the species from the various horizons. Each specimen bears the record, in feet, of its level or depth from the mouth of shaft, and we are therefore able to sum-

marize the succession of the faunas in this section in such a manner as has probably never before been possible in an equal thickness of the Palæozoic rocks. These data have been brought together on the basis of the geological section prepared by Mr. Luther, which will be communicated with the final report on these investigations. The value of such a communication would be enhanced by the description and illustration of such new or little known species as have been obtained from the shaft. Unfortunately, however, there is at present no portion of the Museum appropriation available for drawing and we are therefore seriously handicapped in any effort to illustrate our collections. It might be suggested that the investment of even a moderate sum for drawing, *pays*, not alone because of the increase in scientific value of the specimens so illustrated, but their intrinsic value is thereby greatly exhanced and the Museum is thus substantially and materially the gainer.

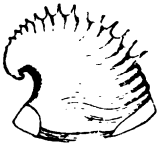
Among the interesting additions to the general collections is a series of fossils from the Corniferous limestone in the towns of Cass and Waverly, Indiana. These have been generously presented to the Museum by Mr. E. H. Raymour, of Kansas City, Mo., in return for identification of species. The assemblage of species is essentially the same in both these localities and comprises an intermixture of forms, which in the New York sections where the faunas are more sharply differentiated, characterize partly the Corniferous limestone, partly the Hamilton shales. The fauna is suggestive of that occurring in the Hydraulic and Encrinal limestones, lying above the Upper Helderberg group at the Falls of the Ohio, but the typical Corniferous limestone species are more abundant. It appears to represent both of the faunas mentioned. The detailed stratigraphy of this region is not reported, but all the material examined from the two localities is identical in lithological structure and fossil contents.

The following is a

LIST OF SPECIES IDENTIFIED:

NAME.	Cass.	Waverly.	Corniferous limestone, N. Y.	Hamilton, N. Y.
Rhynchonella Tethys	*		*	
R. Horsfordi		*		*
Pentamerella arata	*		*	
P. dubia		*		
P. læviuscula	*	*		
Terebratula Harmonia	*	*		
cf. *Lincklæni*		*		*
Camarospira? eucharis (abundant)	*	*	*	
Athyris spiriferoides		*	*	*
Atrypa reticularis	*	*	*	*
Spirifer fimbriatus	*	*	*	*
Sp. audaculus		*		*
Sp. macronotus or *asper*		*		*
Sp. divaricatus	*	*	*	*
Sp. segmentus	*			
Sp. sp. nov. *	*	*		
Trematospira hirsuta	*	*		*
Strophеodonta inæquistriata	*			*
S. hemisphærica		*	*	
Cyrtina curvilineata		*		
Productella navicella	*	*	*	*
Aviculopecten terminalis	*	*	*	
Conocardium trigonale		*	*	
Cypricardinia indenta		*	*	*
Paracyclas elliptica		*	*	
Platyceras erectum		*	*	
Orthonychia concavum		*	*	
Euomphalus Decewi		*	*	
Bellerophon Pelops		*	*	
Isonema sp. n.		*		
Cyrtonella sp. n. †		*		
Proetus crassimarginatus		*	*	
P. macrocephalus	*	*		*
Phacops cristata var. *pipa*		*	*	

* This is a small shell with low, sparse plications which are prominent at the umbones. The surface is covered with fine, linear, radial striæ, a type of exterior which is rare in the Devonian.

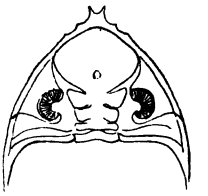


Cyrtonella horrida, sp. nov.

† A species with a sharply carinate nodose dorsum, each node being produced into a stout spine. This is altogether a novel style of ornament among the Bellerophontids. It is interesting to observe that near the aperture where some of the species are broken off, it is very evident that the latter were extensions of the outer shell-layer only, and did not open on the inner surface of the shell.

Some fossil crustacea of considerable interest, and new to our collections, have been received. Prof. J. F. Whiteaves of the Geological Survey of Canada, has sent specimens of his recently-described Phyllopod (?) *Anomalocaris Canadensis*, from the Cambrian fauna of Mt. Stephen, British Columbia. From the Peabody Museum, Yale University, through Prof. C. E. Beecher, we have obtained an interesting series of the Cambrian trilobite, *Ptychoparia Kingi*, numbering about sixty specimens. By purchase the museum secured from Mr. L. G. Rexford, a remarkably

fine specimen of *Asaphus maximus*, Locke, from the Hudson River sandstones in the quarries at Rexford Flats, Saratoga county. The fact that fossils have been almost unknown in these rocks renders this large and entire trilobite altogether unique. Principal J. M. Dolph, of Port Jervis, has contributed a series of fossils from the "trilobite ledge" at that place, among them an interesting undescribed species of trilobite with the general aspect of *Dalmanites dentatus*, Barrett, but having the row of marginal spines restricted to the anterior curve of the head, and the spines themselves much produced on the frontal margin.



The cephalon of *Dalmanites Dolphi*, sp. nov.

Types and Typical Specimens.— There has been a prevalent and unwarranted misapprehension, which has sometimes led to misstatements, in regard to the number of *types of fossils* or original specimens from which generic and specific descriptions have been drawn, belonging to the palæontological collections of the Museum. Such specimens form an important element in the scientific valuation of any collection, and, therefore, to have definite information with reference to their number and character, as well as to afford convenient lists for the use of workers both in and out of this Museum, I submitted to you in my last report a detailed inventory of all *types* and *illustrated specimens* of the *Palæozoic Crustacea* in our possession, with a citation of every work in which such illustrations have appeared. This list summarized as follows:

Original specimens	248
Total illustrated specimens	496

Herewith I communicate similar lists covering the *Annelida* and *Cephalopoda*, of which the totals are:

Original specimens	205
Total illustrated specimens	408

It is my desire and intention to continue these lists in future reports, until we have a completed statement of the number of our typical specimens of fossils of all zoological groups.

Respectfully submitted,

J. M. CLARKE,
Assistant Palæontologist.

Additions to the Geological and Palæontological Collections During the Year 1891-92.

By Donation.

	Number of specimens.
The Albany Institute, Albany, N. Y.:	
Collection of Fossils as listed in the Report of the State Geologist for 1890–1, about	500
John Young, Esq., Glasgow, Scotland:	
Athyris trinuclea, Carboniferous limestone, Glasgow	7
E. H. Raymour, Esq., Kansas City, Mo.:	
Platystoma, Corniferous limestone, Hagarsville, Ont.	1
Amphigenia elongata, Corniferous limestone, Hagarsville, Ont	1
Euomphalus Deceive, Corniferous limestone, Cass Co., Ind.	2
Spirifer divaricatus, Corniferous limestone, Cass Co., Ind.	3
S. fimbriatus, Corniferous limestone, Cass Co., Ind.	2
Trematospira hirsuta, Corniferous limestone, Cass Co., Ind.	3
Camarospira eucharis, Corniferous limestone, Cass Co., Ind.	5
Terebratula Harmonia, Corniferous limestone, Cass Co., Ind.	2
Spirifer fimbriatus, Corniferous limestone, Waverly, Ind.	8
Athyris spiriferoides, Corniferous limestone, Waverly, Ind.	2
Atrypa reticularis, Corniferous limestone, Waverly, Ind.	4
Productella navicella, Corniferous limestone, Waverly, Ind.	7
Rhynchonella Horsfordi, Corniferous limestone, Waverly, Ind.	7
Pentamerella læviuscula, Corniferous limestone, Waverly, Ind.	4
P. dubia, Corniferous limestone, Waverly, Ind.,	11
Camarospira eucharis, Corniferous limestone, Waverly, Ind.	23

	Number of specimens.
Terebratula Harmonia, Corniferous limestone, Waverly, Ind	1
T. sp. n., Corniferous limestone, Waverly, Ind	1
T. cf. *Lincklæni*, Corniferous limestone, Waverly, Ind	5
T. ?? Corniferous limestone, Waverly, Ind	5
Bellerophon Pelops, Corniferous limestone, Waverly, Ind.	4
Miscellaneous brachiopods, Corniferous limestone, Waverly, Ind	308
lamellibranchs, Corniferous limestone, Waverly, Ind	9
gastropods, Corniferous limestone, Waverly, Ind	57
trilobites, Corniferous limestone, Waverly, Ind	21
crinoids, Corniferous limestone, Waverly, Ind	5
Limestone containing fossils, Corniferous limestone, Cass Co., Ind	50
Strophevdonata inæquistriata, Corniferous limestone, Peru, Ind	2
Camarophoria sp. n., Corniferous limestone, Peru, Ind	8
Terebratula Harmonia, Corniferous limestone, Peru, Ind	1
Cryptonella rectirostra, Hamilton group, Leicester, N. Y.,	2
Spirifer Keokuk ?, Chester group, Valley City, Ill	2
S. perplexus, Coal measures, Kansas City, Mo	3
Athyris subtilita, Coal measures, Kansas City, Mo	2
Athyris, Coal measures, Weston, Mo	32
Productus costatus, Coal measures, Webb City, Mo	1
Orthis resupinata, Coal measures, Webb City, Mo	1
Meekella striatocostata, Coal measures, Weston, Mo	1
Fish remains, Lower Silurian, Cañon City, Cal	18
Prof. Samuel Calvin, Iowa City, Ia.:	
Fossils illustrating section at Littleton, Ia., (See Rept. N. Y. State Geologist for 1890–91)	33
Dr. D. F. Lincoln, Geneva, N. Y.:	
Hyolithes sp. nov., Corniferous limestone, near Geneva, N. Y	1

	Number of specimens.
Orthoceras sp. nov.? Corniferous limestone, near Geneva, N. Y	1
Spirifer sp.? Corniferous limestone, near Geneva, N. Y	1
Chonostrophia reversa, Corniferous limestone, near Geneva, N. Y	1
Lepidodendron sp. nov., Corniferous limestone, near Geneva, N. Y	1
Gyathocrinus sp.? Hamilton group, near Bellona, N. Y	1
Prof. Henry M. Seely, Middlebury, Vt.:	
Fossils from the calciferous beds, Fort Cassin, Vt	15
Fossils from the calciferous beds, Providence Island, Vt	4
Fossils from the calciferous beds, Shoreham, Vt	1
Fossils from the calciferous beds, Beekmantown, N. Y	2
Fossils from the Chazy beds, Ferrisburgh, Vt	5
Fossils from the Chazy beds, Sawyer's Bay, Vt	1
George Sisson, Esq., East Berne, N. Y.:	
Devonian fossils, Albany county	3
Prof. J. F. Whiteaves, (Geological Survey of Canada), Ottawa:	
Anomalocaris Canadensis, Cambrian, Mt. Stephen, B. C	2
Peabody Museum, Yale University (through Prof. C. E. Beecher):	
Ptychoparia Kingi, Cambrian, S. E. Nevada	60
Asaphiscus Wheeleri, Cambrian, S. E. Nevada	5
The State Geologist. Trilobites from the Cambrian shales at Ratcliff's Mill, Hanford brook, New Brunswick:	
Harttia, *Conocephalites*, *Paradoxides*, *Agnostus*, etc. A list will be given hereafter	60
The Assistant Palæontologist. Etchings from the Hamilton group, Canandaigua Lake, N. Y.:	
Bryozoa	149
Brachiopods	745
Pteropods	80
Annelids	69
Trilobites	28

BY EXCHANGE.

	Number of specimens.
C. A. Davis, Esq., Alma, Mich.:	
Lot of fossils, Hamilton group, Thunder Bay, Mich.. ...	32
The E. M. Museum of Geology and Ethnology, Princeton, N. J.:	
Slab of *Melonites multipora*	1
Sequoia affinis, Eocene? Florisant, Cal	2
Planera longifolia, Eocene? Florisant, Cal	1
Myricophyllum callicoma, Eocene? Florisant. Cal	1
Glyptostrobus Europæus, Eocene? Florisant, Cal.....	1
Rhus Haydeni, Eocene? Florisant, Cal.....	1
Populus Heeri, Eocene? Florisant, Cal....	1
Prin. J. M. Dolph, Port Jervis, N. Y.:	
Specimens from the *trilobite ledge*, mostly Trilobites and Brachiopods, Lower Helderberg(?), Port Jervis, N. Y...	913

BY PURCHASE.

L. G. Rexford, Rexford Flats, N. Y.:	
Isotelus maximus? A large and entire individual from the Hudson River sandstone (blue stone), Rexford Flats...	1

BY COLLECTION.

Livonia Salt Shaft (D. D. Luther):	
Rocks and fossils from the Hamilton, Upper Helderberg, Lower Helderberg, Oriskany and Onondaga formations. Forty-eight boxes.	
Martin Sheehy and W. F. Cooper:	
Graptolites and Brachiopods from the Hudson River slates at Mt. Merino, 1½ m. S. E. of Hudson, N. Y.....	600
Total specimens (in drawers).....	3,119
Total boxes.....	48

DEPARTMENT OF GEOLOGY AND PALÆONTOLOGY.

List of the Original and Illustrated Specimens in the Palæontological Collections.

Part II.—Annelida and Cephalopoda.

Prepared by JOHN M. CLARKE, Assistant Palæontologist.

List of the Original and Illustrated Specimens in the Palæontological Collections.

PART II.

ANNELIDA

EUNICITES, Ehlers. 1868.

Eunicites?

J. M. Clarke, in 6th Annual Report of the New York State Geologist, 1887, p. 30, pl. A 1, fig. 28.

Hamilton group. Canandaigua, N. Y.

J. M. Clarke purchase.

ŒNONITES, Hinde. 1879.

Œnonites.

Ditto in 6th Annual Report of the New York State Geologist, 1887, p. 30, pl. A 1, fig. 29.

Hamilton group. Canandaigua, N. Y.

J. M. Clarke purchase.

ARABELLITES, Hinde. 1879.

Arabellites sp.

Ditto in 6th Annual Report of the New York State Geologist, 1887, p. 30, pl. A 1, fig. 23.

Hamilton group. Canandaigua, N. Y.

J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig 24.

Hamilton group. Canandaigua, N. Y.

J. M. Clarke purchase.

Ditto in 6th Annual report of the New York State Geologist, 1887, p. 30, pl. A 1, fig. 25.

Marcellus shale. Canandaigua, N. Y.

J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 26.

Hamilton group. Canandaigua, N. Y.

J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 27.

Hamilton group. Canandaigua, N. Y.

J. M. Clarke purchase.

PRIONIODUS, Pander. 1856.

Prioniodus spicatus, Hinde. 1879.

Quarterly Journal Geological Society, vol. 35, p. 361.

Ditto in 6th Annual Report of the New York State Geologist, 1887, p. 30, pl. A 1, fig. 22.

Naples shales. Naples, N. Y.

J. M. Clarke purchase.

POLYGYNATHUS, Hinde. 1879.

Polygnathus serratus, Hinde. 1879.

Quarterly Journal Geological Society, vol. 35, p. 365.

Ditto in 6th Annual Report of the New York State Geologist, 1887, p. 30, pl. A 1, fig. 21.

Naples shales. Naples, N. Y.

J. M. Clarke purchase.

Polygnathus cristatus, Hinde. 1879.

Quarterly Journal Geological Society, vol. 35, p. 366.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 20.

Naples Shales. Naples, N. Y.

J. M. Clarke purchase.

Polygnathus solidus, Hinde, 1879.

Quarterly Journal Geological Society, vol. 35, p. 365.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 11.

Naples shales. Naples, N. Y.

J. M. Clarke purchase.

Polygnathus tuberculatus, Hinde. 1879.

Quarterly Journal of the Geological Society, vol. 35, p. 366.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 17.

Naples beds. Naples, N. Y.

J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 18.
Naples beds. Naples, N. Y.

J. M. Clarke purchase.

Polygnathus dubius, Hinde. 1879.

Quarterly Journal of the Geological Society, vol. 35, p. 362.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 1.
Naples beds. Naples, N. Y.

J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 2.
Naples beds. Naples, N. Y.

J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 3.
Naples beds. Naples, N. Y.

J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 4.
Naples beds. Naples, N. Y.

J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 5.
Naples beds. Naples, N. Y.

J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 6.
Naples beds. Naples, N. Y.

J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 7.
Naples beds. Naples, N. Y.

J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 8.
Naples beds. Naples, N. Y.
J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 10.
Naples beds. Naples, N. Y.
J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 12.
Naples beds. Naples, N. Y.
J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 13.
Naples beds. Naples, N. Y.
J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 14.
Naples beds. Naples, N. Y.
J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 15.
Naples beds. Naples, N. Y.
J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 16.
Naples beds. Naples, N. Y.
J. M. Clarke purchase.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1, fig. 19.
Naples beds. Naples, N. Y.
J. M. Clarke purchase.

Polygnathus pennatus, Hinde. 1879.
Quarterly Journal Geological Society, vol. 35, p. 366.

Ditto in 6th Annual Report of the New York State Geologist, p. 30, pl. A 1. fig. 9.
Naples beds. Naples, N. Y.
J. M. Clarke purchase.

CORNULITES, Schlotheim. 1820.

Cornulites proprius, Hall. 1876.

Twenty-eighth Annual Report N. Y. State Museum, p. 182.

Palæontology of New York, vol. v, pt. 2. Suppl.=vol. vii, pl. 116, fig. 19.

Niagara group. Waldron, Indiana.

Collected by C. Van Deloo, 1878.

Palæontology of New York, vol. 5, pt. 2. Suppl.=vol. vii, pl. 116, fig. 7.

Niagara group. Waldron, Indiana.

Collected by C. D. Walcott and C. Van Deloo, 1878.

Palæontology of New York, vol. v, pt. 2. Suppl. =vol. vii, pl. 116 fig. 8.

Niagara group. Waldron, Indiana.

Collected by C. D. Walcott and C. Van Deloo, 1878.

Cornulites tribulis, Hall. 1888.

Palæontology of New York, vol. v, pt. 2. Suppl.=vol. vii, p. 20, pl. 116, fig. 30.

Hamilton group. Hopewell, N. Y.

J. M. Clarke purchase.

CEPHALOPODA.

ORTHOCERAS, Breyn. 1732.

Orthoceras laqueatum, Hall. 1847.

Palæontology of New York, vol. i, p. 13, pl. 3, fig. **12.**
Calciferous sandrock. (Locality?) New York.
Geological Survey collection.

Orthoceras primigenium, Vanuxem. 1842.

Geology of New York, Report Third District, p. 36.

Palæontology of New York, vol. i, p. 13, pl. 3, figs. **11, 11a.**
Calciferous sandrock. Near Fort Plain, N. Y.
Geological Survey collection.

Orthoceras tenuiseptum, Hall. 1847.

Palæontology of New York, vol. 1, p. 35, pl. 7, fig. **6.**
Chazy limestone. Chazy, N. Y.
Geological Survey collection.

Orthoceras fusiforme, Hall. 1847.

Palæontology of New York, vol. i, p. 60, pl. 20, fig. **1.**
Black River limestone. Watertown, N. Y.

Orthoceras coraliferum, Hall. 1847.

Palæontology of New York, vol. i, p. 312, pl. 85, fig. **3.**
Utica slate. Turin, N. Y.
Geological Survey collection.

Palæontology of New York, vol. i, pl. 86, fig. **1c.**
Hudson River group. Lewis county.
Geological Survey collection.

Orthoceras simulator, Hall. 1882.

Eleventh Annual Report State Geologist of Indiana, p. 322, pl. 33, figs. **1, 2.**
Niagara group. Waldron, Indiana.
Collected by C. D. Walcott and C. Van Deloo, 1878.

Orthoceras Amycus, Hall. 1882.

Eleventh Annual Report State Geologist of Indiana, p. 324, pl. 33, figs. **3, 4.**

Niagara group. Waldron, Indiana.

Collected by C. D. Walcott and C. Van Deloo, 1878.

Orthoceras pauciseptum, Hall. 1859.

Palæontology of New York, vol. vii, p. 346, pl. 72, figs. **5a, b.**

Lower Helderberg group (Shaly limestone). Schoharie, N. Y.

J. Gebhard purchase.

Orthoceras arenosum, Hall. 1859.

Palæontology of New York, vol. iii, p. 480, **not figured.**

Oriskany sandstone. Schoharie, N. Y.

J. Gebhard purchase.

Orthoceras masculum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 238, pl. 78b, fig. **1.**

Schoharie grit. Clarksville, N. Y.

Orthoceras cingulum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 240, pl. 76, fig. **2.**

Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 76, fig. **3.**

Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Orthoceras Pelops, Hall. 1861.

Descr. New Species Fossils, p. 45.

Palæontology of New York, vol. v, pt. 2, 1879, pl. 35a, fig. 6.

Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, 1879, pl. 35, figs. 2, 2a, 3.

Schoharie grit. The Helderberg, N. Y.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 35, fig. **2.**

Palæontology of New York, vol. v, pt. 2, 1879, pl. 35, fig. **1.**

Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, 1879, pl. 35a, fig. 5.
Schoharie grit. Knox, N. Y.

Collected by C. Van Deloo, 1862.

Palæontology of New York, vol. v, pt. 2, 1879, pl. 35a, figs. 1, 2, 3.
Schoharie grit. Near Clarksville, N. Y.

Collected by R. P. Whitfield and C. Van Deloo, 1861.

Palæontology of New York, vol. v, pt. 2, 1879, pl. 35a, fig. 4.
Schoharie grit. The Helderberg, N. Y.

Palæontology of New York, vol. v, pt. 2, 1879, pl. 78b, fig. 2.
Schoharie grit. Knox, N. Y.

Collected by C. Van Deloo, 1862.

Orthoceras tantalus, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 241 pl. 35a, fig. **7.**
Schoharie grit. Clarksville, N. Y.

Palæontology of New York, vol. v, pt. 2, pl. 35a, fig. **10.**
Schoharie grit. Clarksville, N. Y.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 35, fig. 1 (part).
Palæontology of New York, vol. v, pt. 2, pl. 35, fig. **10.**
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 35, fig. 1 (part).
Palæontology of New York, vol. v, pt. 2, pl. 35, figs. **8, 9.**
Schoharie grit. Schoharie, N. Y.

J. Gebbard purchase.

Orthoceras fluctum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 239, pl. 76, figs. **5, 6.**
Schoharie grit. Near Clarksville, N. Y.

Palæontology of New York, vol. v, pt. ., pl. 76, figs. **4, 7.**
Schoharie grit. Near Clarksville, N. Y.

Orthoceras luxum, Hall. 1876.

Ill. Devon. Fossils, pl. 35, fig. 5.

Palæontology of New York, vol. v, pt. 2, pl. 35, fig. 7.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 77, fig. 8; pl. 78b, fig. 3.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils; Cephalopoda, pl. 35, fig. 3. (*O. Pelops*).
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 81, fig. 13.
Schoharie Grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 112, fig. 12.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 112, fig. 13.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 112, fig. 14.
Schohorie grit. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils; Cephalopoda, pl. 35, fig. 1. (*O. Pelops*).
Palæontology of New York, vol. v. pt. 2, pl. 35, fig. 5.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 35, fig. 6.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 76, fig. 1.
Schoharie grit. Near Clarksville, N. Y.

Collected by R. P. Whitfield and C. Van Deloo, 1861.

Palæontology of New York, vol. v, pt. 2, pl. 78, fig. 7.
Schoharie grit. Near Clarksville, N. Y.
Collected by R. P. Whitfield and C. Van Deloo, 1861.

Palæontology of New York, vol. v, pt. 2, pl. 77, fig. 5.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 77, fig. 6.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 77, fig. 7.
Schoharie grit, Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 77, fig. 4.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 77, fig. 1.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 77, fig. 2.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 77, fig. 4.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 78, figs. 5, 6.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 35, fig. 4.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Orthoceras collatum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 252, pl. 80, fig. 1.
Schoharie grit. Schoharie N. Y.
J. Gebhard purchase.

Orthoceras Zeus, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 235, pl. 75, figs. **1, 3.**
Schoharie grit. The Helderberg, N. Y.

Palæontology of New York, vol. v, pt. 2, pl. 75, fig. **2.**
Schoharie grit. Near Clarksville, N. Y.
Collected by C. Van Deloo, 1862.

Orthoceras tetricum, Hall. 1861.

Descr. New Species Fossils, p. 45.

Palæontology of New York, vol. v, pt. 2, pl. 80, fig. 2.
Schoharie grit. Near Clarksville, N. Y.
Collected by C. Van Deloo, 1862.

Palæontology of New York, vol. v, pt. 2, pl. 78b, fig. 4.
Schoharie grit. Near Clarksvillle, N. Y.
Collected by C. Van Deloo, 1862.

Palæontology of New York, vol. v, pt. 2, pl. 80, fig. 8.
Schoharie grit. Schoharie N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 80, figs. 5, 6.
Schoharie grit. Near Clarksville, N. Y.
Collected by C. Van Deloo, 1862.

Palæontology of New York, vol. v, pt. 2, pl. 80, fig. 9.
Schoharie grit. Near Clarksville, N. Y.
Collected by C. Van Deloo, 1862.

Orthoceras procerus, Hall. 1876.

Illustrations of Devonian Fossils: Cephalopoda, pl. 35, fig. **4.**
Palæontology of New York, vol. v, pt. 2, pl. 35, fig. **15.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 35, fig. 16: pl. 78 A, fig. 1.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 78 A, figs. 2, 3.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 78 A, figs. 4, 5.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 78 A, figs. 6, 7.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 78 A, fig. 8.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 79, figs. 5, 6.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 79, figs. 7, 8.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Orthoceras carnosum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 258, pl. 39, fig. **11.**
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Orthoceras stylus, Hall. 1879.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 36, fig. 3 (*O. baculum*).
Palæontology of New York, vol. v, pt. 2, pl. 36, fig. **2**; pl. 79, fig. **1.**
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 36, fig. **4.**
Palæontology of New York, vol. v, pt. 2, pl. 36, fig. 3.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 79, fig. 3.
Schoharie grit. Schoharie N. Y.

J. Gebhard purchase.

Orthoceras varum, Hall. 1879.

Palæontology of New York, vol. v, pl. 2, p. 259, pl. 79, fig. **2**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 79, fig. **4**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 112, figs. **5, 6**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Orthoceras pervicax, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 257, pl. 79, figs. **9, 10**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Orthoceras oppletum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 248, pl. 81, figs. **9, 10, 11**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 81, fig. **12**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 112, fig. **11**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard, purchase.

Orthoceras vastator, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 243, pl. 78, figs. **1, 2**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 78, fig. **3**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 78, fig. **4**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Orthoceras pravum, Hall. 1879.

(= *O. tetricum*, Hall, 1861, Descr. New Species Fossils, p. 45.)

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 36, fig. **2.**
Palæontology of New York, vol. v, pt. 2, p. 255, pl. 36, fig. **2.**
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 81, fig. **1.**
Schoharie grit. Near Clarksville, N. Y.

Collected by C. Van Deloo, 1862.

Palæontology of New York, vol. v, pt. 2, pl. 81, figs. **2, 5;** pl. 112, fig. **17.**
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 81, figs. **3, 4;** pl. 112, fig. **16.**
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 81, fig. **6.**
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 81, fig. **15.**
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Orthoceras medium, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 254, pl. 79, figs. **11, 12.**
Schoharie grit. Schoharie.

J. Gebhard purchase.

Orthoceras Thoas, Hall. 1861.

Descr. New Species Fossils, p. 47.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 41, fig. 1; Palæontology of New York, vol. v, pt. 2, 1879, pl. 41, fig. 1.
Corniferous limestone. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 41, fig. 2; Palæontology of New York, vol. v, pt. 2, 1888, pl. 41, fig. 2.
Corniferous limestone. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 41, fig. 8; Palæontology of New York, vol. v, pt. 2, 1879, pl. 41, fig. 8.
Corniferous limestone. Clarence, N. Y.
Collected by C. A. White, R. P. Whitfield and C. Van Deloo, 1860.

Illustrations of Devonian Fossils, 1876; Cephalopoda pl. 41, fig. 5; Palæontology of New York, vol. v, pt. 2, 1879, pl. 41, fig. 5.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda pl. 41, fig. 3; Palæontology of New York, vol. v, pt. 2, 1879, pl. 41, fig. 3.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 41, fig. 6; Palæontology of New York, vol. v, pt. 2, 1879, pl. 41, fig. 6.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, 1879, pl. 78b, fig. 5.
Schoharie grit. Near Clarksville, N. Y.

C. Van Deloo, 1866.

Palæontology of New York, vol. v, pt. 2, 1879, pl. 80, fig. 10.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, 1879, pl. 80, fig. 11.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, 1879, pl. 112, figs. 7, 8.
Corniferous limestone. Caledonia, N. Y.

Collected by C. A. White, 1860.

Orthoceras multicinctum, Hall. 1861.

Descr. New Species Fossils, p. 48.

Fifteenth Annual Report of the New York State Cabinet of Natural History, pl. 7, fig. **3**; Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 43, fig. **1**; and Palæontology of New York, vol. v, pt. 2, pl. 43, fig. **1**.

Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Fifteenth Annual Report of the New York State Cabinet of Natural History, pl. 7, fig. **2**; Illustrations of Devonian Fossils, 1876, Cephalopoda, pl. 43, fig. **2**; and Palæontology of New York, vol. v. pt. 2, pl. 43, fig. **2**.

Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 43, fig. 3; and Palæontology of New York, vol. v, pt. 2, pl. 43, fig. 3.

Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Orthoceras duramen, Hall. 1886.

Fifth Annual Report of the New York State Geologist, Expl. pl. (117) 1, fig. **1**; Palæontology of New York, vol. v, pt. 2, Suppl.= vol. vii, p. 25, pl. 117, fig. **1**.

Schoharie grit. Near Clarksville, N. Y.

Collected by C. Van Deloo, 1862.

Orthoceras sceptrum, Hall. 1886.

Fifth Annual Report of the New York State Geologist, Expl. pl. (117) 1, fig. **2**; Palæontology of New York, vol. v, pt. 2, Suppl.= vol. viii, pl. 117, fig. **2**.

Upper Helderberg limestone. Cherry Valley, N. Y.

Collected by J. W. Hall, 1877.

Orthoceras inoptatum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 267, pl. 112, figs. **9, 10**.

Corniferous limestone. Clarence, N. Y.

Orthoceras profundum, Hall. 1861.

Descr. New Species Fossils, p. 48.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 37, fig. 5.
Palæontology of New York, vol. v, pt. 2, pl. 37, fig. 5.
Corniferous limestone. Black Rock, N. Y.

J. Gebhard purchase.

Orthoceras Thestor, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 302, pl. 82, fig. **18.**
Marcellus shales. Schoharie, N. Y.

J. Gebhard purchase.

Orthoceras Marcellense, Vanuxem. 1842.

Geology of New York; Rept. Third Dist., p. 147.

Palæontology of New York, vol. v, pt. 2, p. 278, pl. 83, figs. 10, 12.
Goniatite limestone. Near Manlius, N. Y.

Collected by H. H. Smith, 1873.

Palæontology of New York, vol. v, p. 2, pl. 83, fig. 1.
Goniatite limestone. Near Manlius, N. Y.

Collected by H. H. Smith, 1873.

Palæontology of New York, vol. v, pt. 2, pl. 83, fig. 3.
Goniatite limestone. Marcellus, N. Y.

Collected by C. A. White, 1860.

Palæontology of New York, vol. v, pt. 2, pl. 83, fig. 6.
Goniatite limestone. Near Manlius, N. Y.

Collected by H. H. Smith, 1873.

Palæontology of New York, vol. v, pt. 2, pl. 83, fig. 9.
Goniatite limestone. Marcellus, N. Y.

Collected by C. A. White, 1860.

Palæontology of New York, vol. v, pt. 2, pl. 38, fig. 6.
Goniatite limestone. Falls of Oneida Creek, N. Y.

Orthoceras aptum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, pl. 38, fig. **8.**
Goniatite limestone. Near Manlius, N. Y

Orthoceras fustis, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, pl. 83, fig. **11**; pl. 113, figs. **16, 17.**

Goniatite limestone. Schoharie, N. Y.

J. Gebhard purchase.

Orthoceras rudens, Hall. 1886.

Fifth Annual Report of the New York State Geologist, expl. pl. (118) 2, fig. **2.**

Palæontology of New York, vol. v, pt. 2, Suppl.=vol. vii, p. 28, pl. 118, fig. **1.**

Hamilton (?) group. Livingston county, N. Y.

Pickett purchase.

Orthoceras subulatum, Hall. 1843.

Geology of N. Y.; Rept. Fourth Dist., p. 180.

Palæontology of New York, vol. v, pt. 2, pl. 84, fig. 1.
Hamilton group. Pratt's Falls, N. Y.
Collected by C. Van Deloo and H. H. Smith, 1874.

Palæontology of New York, vol. v, pt. 2, pl. 84, figs. 6, 10.
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Palæontology of New York, vol. v, pt. 2, pl. 84, figs. 7, 7+.
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Palæontology of New York, vol. v, pt. 2, pl. 84, fig. 8.
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Palæontology of New York, vol. v, pt. 2, pl. 86, figs. 1, 2.
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Orthoceras exile, Hall. 1861.

Descr. New Species Fossils, p. 50.

Fifteenth Annual Report of the New York State Cabinet of Natural History, 1862, p. 78, pl. 8, fig. **5.**

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 39, fig. **3.**

Palæontology of New York, vol. v, pt. 2, pl. 39, fig. **3.**

Hamilton group. Cazenovia, N. Y.

L. Lincklaen, donor.

Palæontology of New York, vol. v, pt. 2, pl. 85, fig. 14.
Hamilton group. Norton's Landing, Cayuga Lake.
Collected by J. W. Hall, 1866.

Palæontology of New York, vol. v, pt. 2 pl. 85, fig. 15.
Hamilton group. Norton's Landing, Cayuga Lake.
Collected by J. W. Hall, 1866.

Orthoceras Telamon, Hall. 1879.

Palæontology of New York, p. 291, pl. 83, figs. **3, 4**.
Hamilton group. Canandaigua Lake, N. Y.

Palæontology of New York, pl. 83, fig. **12**.
Hamilton group. Canandaigua Lake, N. Y.
Collected by R. P. Whitfield and J. W. Hall, 1858.

Orthoceras emaceratum, Hall. 1879.

15th Ann. Rept. State Cab., p. 170.

Palæontology of New York, vol. v, pt. 2, pl. 85, fig. 16.
Hamilton group. Jaycox's Run, Geneseo.
Collected by C. Van Deloo, 1865.

Orthoceras Bebryx, Hall. 1876.

Illustrations of Devonian Fossils; Cephalopoda, Expl. pl. 39, fig. **2**.
Palæontology of New York, vol. v, pt. 2, pl. 39, fig. **2**.
Hamilton group. Cazenovia, N. Y.
L. Lincklaen, donor.

Palæontology of New York, vol. v, pt. 2, pl. 38, fig. 10.
Hamilton group. Cazenovia, N. Y.
L. Lincklaen, donor.

Palæontology of New York, vol. v, pt. 2, pl. 83, fig. 14.
Hamilton group. Skaneateles Lake, N. Y.
Collected by G. B. Simpson, 1863.

Palæontology of New York, vol. v, pt. 2, pl. 84, fig. 11.
Hamilton group. York, N. Y.
Collected by C. Van Deloo, 1865.

Orthoceras Eriense,

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 40, fig. **4** (*O. robustum*).

Palæontology of New York, vol. v, pt. 2, p. 274, pl. 40, fig. **4**.
Hamilton group. Otisco N. Y.

Palæontology of New York, vol. v, pt. 2, pl. 87, figs. **1, 2**.
Hamilton group. Shore of Lake Erie.

Orthoceras linteum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 277, pl. 87, figs. **3, 4**.
Hamilton group. Near Leonardsville, N. Y.
Collected by F. B. Meek, R. P. Whitfield and C. Van Deloo, 1857.

Orthoceras sp., Hall. 1879.

Palæontology of New York, vol. v, pt. 2, pl. 83, fig. 13.
Hamilton group. Bosanquet, Province of Ontario.
Collected by J. De Cew, 1865.

Orthoceras aulax, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 293, pl. 84, fig. **18**.
Hamilton group. Hamburgh, N. Y.
Collected by J. W. Hall and C. Van Deloo, 1865.

Orthoceras Œdipus, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 294, pl. 37, fig. **6**.
Hamilton group. Geneseo, N. Y.
Collected by C. A. White and C. Van Deloo, 1860.

Palæontology of New York, vol. 5, pt. 2, pl. 82, fig. **17**.
Hamilton group. Jaycox's Run, Geneseo.
Collected by C. Van Deloo, 1865.

Orthoceras crotalum, Hall. 1861.

Descr. New Species Fossils, p. 50.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 42, fig. 12.
Palæontology of New York, vol. v, pt. 2, pl. 42, fig. 12.
Hamilton group. Geneseo, N. Y.
Collected by C. A. White and C. Van Deloo, 1860.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 42, fig. 2.
Palæontology of New York, vol. v, pt. 2, pl. 42, fig. 2.
Hamilton group. Pratts Falls, N. Y.
Collected by G. B. Simpson, 1871.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 42, fig. 7.
Palæontology of New York, vol. v, pt. 2, pl. 42, fig. 7.
Hamilton group. Otisco Lake, N. Y.
Collected by J. W. Hall and G. B. Simpson, 1872.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 42, fig. 6.
Palæontology of New York, vol. v, pt. 2, pl. 42, fig. 6.
Hamilton group. Pratt's Falls, N. Y.
Collected by G. B. Simpson, 1871.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 42, figs. 5, 11.
Palæontology of New York, vol. v, pt. 2, pl. 42, figs. 5, 11.
Hamilton group. Hamilton, N. Y.

Palæontology of New York, vol. v, pt. 2, pl. 82, fig. 1.
Hamilton group. Pratt's Falls, N. Y.
Collected by G. B. Simpson, 1883.

Palæontology of New York, vol. v, pt. 2, pl. 82, fig. 2.
Hamilton group. Delphi, N. Y.
Collected by G. B. Simpson, 1863.

Palæontology of New York, vol. v, pt. 2, pl. 82, figs. 3, 4.
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Palæontology of New York, vol. v, pt. 2, pl. 82, fig. 5; pl. 113, figs. 13, 13a.
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Palæontology of New York, vol. v, pt. 2, pl. 82, fig. 6.
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Palæontology of New York, vol. v, pt. 2, pl. 82, figs 7, 8.
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Orthoceras nuntium Hall. 1861.

Descr. New Species Fossils, p. 51.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 43, fig. 10.
Palæontology of New York, vol. v, pt. 2, pl. 43, fig. 10.
Hamilton group. Geneseo, N. Y.
Collected by C.A. White and C. Van Deloo, 1860.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 43, figs. 6, 7.
Palæontology of New York, vol. v, pt. 2, pl. 43, figs. 6, 7.
Hamilton group. Hamburgh, N. Y.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 43, fig. 14
Palæontology of New York, vol. v, pt. 2, pl. 43, fig. 14.
Hamilton group. Geneseo, N. Y.
Collected by C. A. White and C. Van Deloo, 1860.

Orthoceras cœlamen, Hall. 1879.

Illustrations of Devonian Fossils, 1876 ; Cephalopoda, pl. 10, fig. **42**.
Palæontology of New York, vol. v, pt. 2, p. 298, pl. 10, fig. **42**; pl. 82, fig. **16**.
Hamilton group. Muttonville, N. Y.
Collected by C. A. White and C. Van Deloo, 1860.

Palæontology of New York, vol. v, pt. 2, pl. 82, fig. **14**.
Hamilton group. Platt's Falls, N. Y.
Collected by G. B. Simpson, 1871.

Palæontology of New York, vol. v, pt. 2, pl. 82, fig. **15**.
Hamilton group. Pratt's Falls, N. Y.
Collected by G. B. Simpson. 1871.

Orthoceras Ægea, Hall. 1861.

Descr. New Species Fossils, p. 22.

Palæontology of New York, vol. v, pt. 2, pl. 82, fig. **9**.
Hamilton group. Pratt's Falls, N. Y.
Collected by J. W. Hall and G. B. Simpson, 1874.

Palæotology of New York, vol. v, pt. 2, pl. 82, fig. **10**.
Hamilton group. Geneseo, N. Y.
Collected by C. Van Deloo, 1865.

Palæontology of New York, vol. pt. 2, pl. 82, fig. **11**.
Hamilton group. Geneseo, N. Y.
Collected by C. Van Deloo, 1865.

Orthoceras scintilla, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 293, pl. 84, figs. **19, 20.**
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Palæontology of New York, vol. v, pt. 2, pl. 84, fig. **21.**
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Palæontology of New York, vol. v, pt. 2, pl. 113, fig. **6.**
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Palæontology of New York, vol. v, pt. 2, pl. 113, figs. **7, 8, 9.**
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Palæontology of New York, vol. v, pt. 2, pl. 113, figs. **10, 11, 12.**
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Orthoceras pacator, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 307, pl. 89, fig. **1.**
Portage group. Mt. Morris, N. Y.

Palæontology of New York, vol. v, pt. 2, pl. 89, fig. **3.**
Portage group. Mt. Morris, N. Y.

Palæontology of New York, vol. v, pt. 2, pl. 89, fig. **5.**
Portage group. Near Ithaca, N. Y.
Collected by C. Van Deloo, 1874.

Palæontology of New York, vol. 5. pt. 2, pl. 89, fig. **6.**
Portage group. Ithaca, N. Y.
Collected by C. Van Deloo, 1874.

Orthoceras Thyestes, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 306, pl. 88, fig. **2.**
Portage group. Near Watkins, N. Y.
Pickett purchase.

Orthoceras Atreus, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 305, pl. 88, fig. **1.**
Portage group. Roger's Bridge, Genesee River.

Orthoceras Bebryx, var. *Cayuga*, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 276, pl. 86, fig. **3.**
Chemung group. Ithaca, N. Y.
Collected by J. W. Hall and C. Van Deloo, 1866.

Palæontology of New York, vol. v, pt. 2, pl. 86, fig. **4.**
Chemung group. Ithaca, N. Y.
Collected by J. W. Hall and C. Van Deloo, 1866.

Palæontology of New York, vol. v, pt. 2, pl. 86, fig. **5.**
Chemung group. Ithaca, N. Y.
Pickett purchase.

Orthoceras consortale, Hall. 1886.

Fifth Annual Report of the New York State Geologist. Expl. pl. (118) 2, figs. **3, 4, 5.**
Palæontology of New York, vol. v, pt. 2, Suppl. =vol. vii, p. 29, pl. 118, figs. **3. 4, 5.**
Chemung group. Panama, N. Y.
Collected by James Hall, 1870.

Orthoceras expositum, Hall. 1886.

Fifth Annual Report of the New York State Geologist. Expl. pl. (118) 2, fig. **2.**
Palæontology of New York, vol. v, pt. 2, Supp. =vol. vii, p. 29, pl. 118, fig. **2.**
Chemung group. Canton, Penn.
Collected by A. Sherwood.

Orthoceras palmatum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 312, pl. 90, fig. **9, 10.**
Chemung group. Southern New York.

Orthoceras Leander, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 309, pl. 90, figs. **6, 7.**
Chemung group. Near Ithaca, N. Y.
J. W. Hall and C. Van Deloo, 1866.

Orthoceras Demus, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 311, pl. 90, fig. **1.**
Chemung group. Philipsburgh, N. Y.

Palæontology of New York, vol. v, pt. 2, pl. 90, fig. **5.**
Chemung group. Ithaca, N. Y.
Collected by J. W. Hall and G. B. Simpson 1870.

HORMOCERAS, Stokes. 1838.

Hormoceras filosum, Hall. 1847.

Palæontology of New York, vol. i, p. 55, pl. 15, fig. **1c.**
Black River limestone. Watertown, N. Y.

Hormoceras tenuifilum, Hall. 1847.

Palæontology of New York, vol. i, p. 55, pl. 14, figs. **1, 1a, 1b.**
Black River limestone. Watertown, N. Y.
Albany Institute donor, 1892.

Hormoceras? gracile, Hall. 1847.

Palæontology of New York, vol. i, p. 58, pl. 17, fig. **3.**
Black River limestone. Watertown, N. Y.
Albany Institute donor, 1891.

Hormoceras remotiseptum, Hall. 1850.

Third Report on New York State Cabinet of Natural History, p. 173, pl. 4, fig. **3.**
Trenton limestone. Watertown, N. Y.
Geological Survey collection.

ENDOCERAS, Hall. 1847.

Endoceras longissimum, Hall. 1847.

Palæontology of New York, vol. i, p. 59, pl. 18, fig. **1, 1a.**
Black River limestone. Watertown, N. Y.
Albany Institute donor, 1891.

Endoceras duplicatum, Hall. 1847.

Palæontology of New York, vol. i, p. 219, pl. 55, fig. **1.**
Trenton limestone. Middleville, N. Y.
J. Gebhard purchase.

Endoceras proteiformæ, var. *lineolatum*, Hall. 1847.

Palæontology of New York, vol. i, p. 211, pl. 45, figs. **4, c, d.**
Trenton limestone. Middleville, N. Y.

GOMPHOCERAS, Sowerby. 1839.

Gomphoceras clavatum, Hall. 1876.

Ills. Dev. Fossils; Exp. pl. 47, figs. 12, 13.

Palæontology of New York, vol. v, pt. 2, pl. 93, fig. 2.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 93, fig. 3.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Gomphoceras rude, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 327, pl. 93, fig. **1.**
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Gomphoceras cruciferum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 328, pl. 93, fig. **4.**
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Gomphoceras Illænus, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 322, pl. (Suppl. = vol. vii) 122, fig. **6.**
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Gomphoceras fax, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 321, pl. (Suppl. = vol. vii) 122, fig. **5.**
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Gomphoceras beta, Hall. 1861.

Descr. New Species Fossils, p. 44.

Fifteenth Report on the New York State Cabinet of Natural History, p. 72, pl. 7, fig. **1**; Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 47, fig. **5**; Palæontology of New York, vol. v, pt. 2, pl. 46, fig. **4**.

. Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 47, fig. 6; Palæontology of New York, vol. v, pt. 2, pl. 46, fig. 5.

Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Gomphoceras absens, Hall. 1876.

Illustrations of Devonian Fossils, 1876; Cephalopoda. Expl. pl. 47, figs. **7, 8**; Paleontology of New York, vol. v, pt. 2, pl. 46, figs. **8, 9**.

Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, Suppl. (= vol. vii), pl. 122, fig. 1.

Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, Suppl. (= vol. vii), pl. 122, fig. 2.

Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876, Cephalopoda. Expl. pl. 47, figs. 7, 8; Palæontololology of New York, vol. v, pt. 2, Suppl. (= vol. vii), pl. 122, fig. 3.

Corniferous limestone. Clarence Hollow, N. Y.

Gomphoceras mitra, Hall. 1879.

* Palæontology of New York, vol. v. pt. 2. Suppl. (= vol. vii), pl. 121, fig. **3**.

Corniferous limestone. Columbus, Ohio.

Gomphoceras eximium, Hall. 1879.

14th Rept. N. Y. State Cab. Nat. Hist., p. 109.

*Palæontology of New York, vol. v. pt. 2, Suppl. (= vol. vii), pl. 121, fig. 2.

Corniferous limestone. Columbus, Ohio.

Gomphoceras impar, Hall. 1879.

*Palæontology of New York, vol. v, pt. 2, p. 232, Suppl. (=vol. vii), pl. 121 A, fig. 1.

Corniferous limestone. Columbus, Ohio.

Gomphoceras solidum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 338, pl. 93, fig. **9**.

Goniatite limestone. Manlius, N. Y.

L. Lincklaen, donor.

Gomphoceras oviforme, Hall. 1860.

13th Rept. N. Y. State Cab. Nat. Hist., p. 105.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 45, figs. **1, 2,**

Palæontology of New York, vol. v, pt. 2, pl. 45, figs. **2, 3.**

Goniatite limestone. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 47, figs. **3, 4.**

Palæontology of New York, vol. v, pt. 2, pl. 46, figs. **6, 7.**

Goniatite limestone. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 94, fig. 6.

Goniatite limestone. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 94, fig. 7.

Goniatite limestone. Schoharie, N. Y.

J. Gebhard purchase.

Gomphoceras poculum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 340, pl. 93, figs. **7, 8.**

Hamilton group. Cazenovia, N. Y.

Gomphoceras raphanus, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, pt. 347, pl. 94, figs. **2, 3.**
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Palæontology of New York, vol. v, p. 2, pl. 94, fig. **4.**
Hamilton group. Pratt's Falls, N. Y.
Collected by H. H. Smith and C. Van Deloo, 1874.

Palæontology of New York, vol. v, pt. 2, pl. 94, fig. **10.**
Hamilton group. Pratt's Falls, N. Y.
Collected by G. B. Simpson, 1871.

Gomphoceras sp. Hall. 1876.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 60, fig. **7.**
Palæontology of New York, vol. v, pt. 2, pl. 60, fig. **7.**
Hamilton group. Skaneateles Lake, N. Y.
Collected by J. W. Hall and G. B. Simpson, 1872.

Gomphoceras planum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 352, pl. 57, figs. **1, 2.**
Hamilton group. Borodino, N. Y.
W. Emmons, donor.

Gomphoceras manes, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 339 and Suppl. 1888, p. 34, pl. 123, fig. **2.**
Genesee slate. South of Alden, N. Y.

Gomphoceras Ajax, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 350, pl. 94, fig. **8.**
Portage group. Penn Yan, N. Y.
Geological Survey collection.

Gomphoceras tumidum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 351, pl. 95. fig. **5.**
Chemung group. New Albion, N. Y.
Collected by C. Van Deloo, 1863.

Palæontology of New York, vol. v, pt. 2, pl. 95, fig. **2.**
Chemung group. Near Ithaca, N. Y.
Collected by J. W. Hall and C. Van Deloo, 1866.

Palæontology of New York, vol. v, pt. 2, pl. 95, fig. **3.**
Chemung group. Near Ithaca, N. Y.
Collected by J. W. Hall and C. Van Deloo, 1866.

Gomphoceras nasutum, Hall. 1886.

Fifth Annual Report of New York State Geologist. Expl. pl. 120 (4), figs. **5, 7.**
Palæontology of New York, vol. v, pt. 2, Suppl. (= vol. vii) p. 34, pl. 120, figs. **5, 7.**
Chenango group. Belmont, N. Y.
Collected by A. Sherwood, 1871.

Gomphoceras potens, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 351, pl. 122, fig. **8.**
Waverly group. Medina, Ohio.
Collected by C. A. White, 1861.

CYRTOCERAS, Goldfuss. 1832.

Cyrtoceras filosum, Emmons. 1842.

* Geology of New York; Report on the Third District, p. 392, fig. **4.**
Palæontology of New York, vol. i, p 390, pl. 41, fig. **3a.**
Trenton limestone. Watertown, N. Y.

Cyrtoceras macrostomum, Hall. 1847.

* Palæontology of New York, vol. i, p. 194, pl. 42, fig. **1b.**
Trenton limestone. Mineral Point, Wis.

Cyrtoceras eugenium, Hall. 1861.
Descr. New Species Fossils, p. 42.

Fifteenth Annual Report on the New York State Cabinet of Natural History, p. 70, pl. 9, fig. **1.**
Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 46, figs. **5, 6.**
Palæontology of New York, vol. v, pt. 2, pl. 47, figs. **5, 6.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda pl. 46, fig. 7.
Palæontology of New York, vol. v, pt. 2, pl. 47, fig. 7.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 17, fig. 16.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2. pl. 96, fig. 1.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 96, fig. 2.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 96, fig. 3.
Schoharie grit. Clarksville, N. Y.
Collected by C. Van Deloo, 1862.

Palæontology of New York, vol. v, pt. 2, pl. 96, fig. 4.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 96, fig. 5.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 96, figs. 6, 7.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase,

Palæontology of New York, vol. v, pt. 2, pl. 96, figs. 8, 9; pl. 97, fig. 11.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 96, fig. 10.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 96, fig. 11.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Cyrtoceras æmulum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 271, pl. 97, fig. 1.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 97, fig. **2.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 97, fig. **3.**
Schoharie grit. Clarksville, N. Y.
Collected by C. Van Deloo, 1862.

Palæontology of New York, vol. v, pt. 2, pl. 97, figs. **4, 5.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 97, fig. 6.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 97, figs. **8, 9.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Cyrtoceras Jason, Hall. 1861.
Descr. New Species Fossils, p. 43.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 52, fig. **1.**
Palæontology of New York, vol. v, pt. 2, pl. 50, fig. **1.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 52, fig. **2.**
Palæontology of New York, vol. v, pt. 2, pl. 50, fig. **2.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, Suppl. (=vol. vii, 1888), pl. 124, fig. 7.
Schoharie grit. Clarksville, N. Y.

Cyrtoceras morsum, Hall. 1861.
Descr. New Species Fossils, p. 43.

Fifteenth Annual Report on the New York State Cabinet of Natural History, 1862, p. 71, pl. 9, fig. **6.**
Illustrations of Devonian Fossils, pl. 46, figs. **3, 4.**
Palæontology of New York, vol. v, pt. 2, pl. 47, figs. **3, 4.**
Corniferous limestone. Schoharie, N. Y.
J. Gebhard purchase.

Cyrtoceras citum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 372, pl. 51, figs. **1, 2.**
Corniferous limestone. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 51, fig. **3.**
Corniferous limestone. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, Suppl. (= vol. vii, 1888), pl. 124, fig. **1.**
Corniferous limestone. Falkirk, N. Y.

Collected by C. D. Walcott and C. Van Deloo, 1878.

Palæontology of New York, vol. v, pt. 2, Suppl. (= vol. vii, 1888), pl. 124, fig. 2.
Corniferous limestone. Falkirk, N. Y.

Collected by C. D. Walcott and C. Van Deloo, 1878.

Palæontology of New York, vol. v, pt. 2, Suppl. (= vol. vii, 1888) pl. 124, fig. 2.
Corniferous limestone. Cayuga, Ontario.

Collected by C. D. Walcott, 1878.

Cyrtoceras (*Gomphoceras*) *metula*, Hall. 1861.

Descr. New Species Fossils, p. 44.

Palæontology of New York, vol. v, pt. 2, pl. 111, fig. **11.**
Upper Helderberg limestone. Littleville, N. Y.

Collected by C. Van Deloo, 1878.

Cyrtoceras (*Gomphoceras?*) *formosum*, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 362, pl. 95, figs. **8, 9.**
Hamilton group. Dresden, N. Y.

PHRAGMOCERAS, Broderip. 1839.

Phragmoceras expansum, Hall. 1852.

Palæontology of New York, vol. ii, p. 337, pl. 77A, figs. **2a, b.**
Palæontology of New York, vol. v, pt. 2, 1879, pl. 46, figs. **10, 11.**
Coralline limestone. Schoharie, N. Y.

J. Gebhard purchase.

Phragmoceras, Hall. 1852.

(*P. corallophilum*, nom. propos.)

Palæontology of New York, vol. ii, p. 351, pl. 78, fig. **3a.**
Coralline limestone. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. ii, pl. 78, fig. **3b.**
Coralline limestone. Schoharie, N. Y.
J. Gebhard purchase.

GYROCERAS, DeKoninck. 1844.

Gyroceras spinosum, Conrad. 1840.

Geol. Surv. N. Y.; Pal. Dept.; 3d Ann. Rept., p. 206.

Illustrations of Devonian Fossils, 1876; Cephalopoda pl. 50, fig. **3.**
Palæontology of New York, vol. v, pt. 2, pl. 48, fig. **3.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 50, fig. **5.**
Palæontology of New York, vol. v, pt. 2, pl. 48, fig. **2.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 50, fig. **2.**
Palæontology of New York, vol. v, pt. 2, pl. 48, fig. **1.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 30, fig. **1.**
Palæontology of New York, vol. v, pt. 2, pl. 48, fig. **5**; pl. 99, fig. **7.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 46, fig. **8.**
Palæontology of New York, vol. v, pt. 2, pl. 47, fig. **8.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 99, figs. 1, 2.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 98, figs. 1, 2.
Schoharie grit. Clarksville, N. Y.
Collected by R. P. Whitfield and C. Van Deloo, 1861.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 51, fig. **1.**
Palæontology of New York, vol. v, pt. 2, pl. 49, fig. **1.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 50, fig. **4.**
Palæontology of New York, vol. v, pt. 2, pl. 48, fig. **4.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 99, fig. 3.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 99, figs. 4, 7.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 99, figs. 5, 6.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 99, fig. 8.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Gyroceras validum. Hall, 1876.

Illustrations of Devonian Fossils; Cephalopoda, pl. 51, fig. **2.**
Palæontology of New York, vol. v, pt. 2, pl. 49, fig. **2.**
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 100, fig. 1.
Schoharie grit. Knox, N. Y.
Collected by C. Van Deloo, 1862.

Gyroceras paucinodosum. Hall, 1876.

Illustrations of Devonian Fossils; Cephalopoda. Expl. pl. 35, figs. **1, 2, 3, 4.**
Palæontology of New York, vol. v, pt. 2, p. 380, pl. 54, figs. **1, 2, 3, 4.**
Corniferous limestone. Cherry Valley, N. Y.
Collected by C. A. White, 1860.

Gyroceras laciniosum. Hall, 1879.

Palæontology of New York, vol. v, pt. 2, p. 376, pl. 52A, fig. **8**.
Corniferous limestone. Schoharie, N. Y.

J. Gebhard purchase.

Gyroceras Matheri. Conrad (sp.), 1840.

Geol. Surv. N. Y.; Pal. Dept., 3d Ann. Rept., p. 206.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 56, fig. **3**.
Palæontology of New York, vol. v, pt. 2, pl. 55, figs. **3, 4**.
Corniferous limestone. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 55, fig. 5.
Corniferous limestone. Clarksville, N. Y.

Gyroceras Nereus, Hall. 1861.

Descr. New Species Foss., p. 39.

Palæontology of New York, vol. v, pt. 2, Suppl. (=vol. vii, 1888), pl. 124, fig. 4.
Corniferous limestone. Cherry Valley, N. Y.

Gyroceras Cyclops, Hall. 1861.

Descr. New Species Foss., p. 40.

Palæontology of New York, vol. v, pt. 2, pl. 102, fig. 1.
Corniferous limestone. Clarksville, N. Y.

Gyroceras undulatum, Vanuxem. 1842.

Geol. Surv. N. Y.; Rept. 3d Dist., p. 139, fig. 2.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 56, fig. 1.
Palæontology of New York, vol. v, pt. 2, pl. 53, fig. 1.
Corniferous limestone. Cherry Valley, N. Y.

Collected by C. A. White, 1860.

Illustrations of Devonian Fossils; Cephalopoda, pl. 56, fig. 2.
Palæontology of New York, vol. v, pt. 2, pl. 53, fig. 2.
Corniferous limestone. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 53, fig. 3.
Corniferous limestone. Cherry Valley, N. Y.

Collected by C. A. White, 1860.

Palæontology of New York, vol. v, pt. 2, pl. 53, figs. 5, 6.
Corniferous limestone. Cherry Valley, N. Y.
Collected by C. A. White, 1860.

Palæontology of New York, vol. v, pt. 2, pl. 54, fig. 5.
Corniferous limestone. Cherry Valley, N. Y.
Collected by C. A. White, 1860.

Gyroceras trivolve, Conrad. 1840.

Geol. Surv. N. Y.; Pal. Dept.; 3d Ann. Rept., p. 206.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 54, figs. **4, 5**; pl. 56, fig. **4**.
Palæontology of New York, vol. v, pt. 2, pl. 52, figs. **1, 2, 3.**
Corniferous limestone. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 52 A, fig. 4.
Corniferous limestone. The Helderberg, N. Y.

Palæontology of New York, vol. v, pt. 2, pl. 52 A, fig. 5.
Corniferous limestone. The Helderberg, N. Y.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 54, figs. **1, 2, 3.**
Palæontology of New York, vol. v, pt. 2, pl. 52 A, figs. **1, 2, 3.**
Corniferous limestone. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 52, fig. 4.
Corniferous limestone. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2 pl. 52, fig 5.
Corniferous limestone. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 52 A, fig. 6.
Corniferous limestone. Cherry Valley, N. Y.

Gyroceras transversum, Hall. 1860.

13th Rept. N. Y. State Cab. Nat. Hist., p. 104.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 57, figs. **1, 2.**
Palæontology of New York, vol. v, pt. 2, pl. 67, figs. **1, 2.**
Goniatite limestone. Near Manlius, N. Y.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 57, figs. **3, 4**; Palæontology of New York, vol. v, pt. 2, pl. 57, figs. **3, 4.**
Goniatite limestone. Near Manlius, N. Y.

Genus LITUITES, Montfort. 1808.

Lituites convolvans ?, Hall. 1847.

Palæontology of New York, vol. i, p. 53, pl. 13, fig. **2a.**
Black River limestone. Watertown, N. Y.
Albany Institute donor.

Lituites undatus, Hall. 1847.

Palæontology of New York, vol. i, pt. 52, pl. 13, figs. **1a, 1b.**
Black River limestone. Watertown, N. Y.
Albany Institute donor.

NAUTILUS, Breyn. 1732.

Nautilus Oceanus, Hall. 1879.

Transactions of the Albany Institute, vol. x. Abst. p. 19, **not fig'd.**
Eleventh Annual Report of the Indiana State Geologist, 1882, p. 325, **not fig'd.**
Niagara group. Waldron, Ind.

Nautilus liratus, Hall. 1860.
13th Rept. N. Y. State Cab. Nat Hist., p. 104.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 60, figs. **8, 9.**
Palæontology of New York, vol. v, pt. 2, pl. 60, fig. **8, 9.**
Gonialite limestone. Schoharie, N. Y.
J. Gebhard purchase.

Nautilus liratus, var. *juvenis*, Hall. 1579.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 57, figs. **5, 6.**
Palæontology of New York, vol. v, pt. 2, p. 411, pl. 56, figs. **5, 6.**
Hamilton group. Cazenovia, N. Y.
Geological Survey collection.

Nautilus subliratus, Hall. 1879.

Illustrations of Devonian Fossils, pl. 58, fig. **5.**
Palæontology of New York, vol. v, pt. 2, pl. 57, fig. **5.**
Hamilton group. Skaneateles Lake, N. Y.
Collected by G. B. Simpson, 1863.

Nautilus maximus, Conrad. 1838.

Geol. Surv. N. Y.; Pal. Dept., First Ann. Rept., p. 117.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 64, fig. **1.**
Palæontology of New York, vol. v, pt. 2, pl. 64, fig. **1.**
Hamilton group. Madison county, N. Y.

Geological Survey collection.

Nautilus magister, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 422, pl. 107, figs. **6, 7.**
Hamilton group. Hamburgh, N. Y.

Collected by C. A. White, 1860.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 63, fig. **1.**
Palæontology of New York, vol. v, pt. 2, pl. 108, figs. **1, 2.**
Hamilton group. Hamburgh, N. Y.

Collected by C. A. White, 1860.

Palæontology of New York, vol. v, pt. 2, pl. 107, fig. **1.**
Hamilton group. Hamburgh, N. Y.

Collected by C. A. White, 1860.

Palæontology of New York, vol. v, pt. 2, pl. 105, fig. 1.
Hamilton group. Leonardsville, N. Y.
Collected by F. B. Meek, R. P. Whitfield and C. Van Deloo, 1857.

Palæontology of New York, vol. v, pt. 2, pl. 107, fig. 8.
Hamilton group. Hamburgh, N. Y.

Collected by J. W. Hall and C. Van Deloo, 1869.

Nautilus oriens, Hall. 1876.

Illustrations of Devonian Fossils; Cephalopoda, expl. pl. 61, fig. **1.**
Palæontology of New York, vol. v, p. 420, pl. 61, fig. **1.**
Hamilton group. Richmondville, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 105, fig. 2.
Hamilton group. Richmondville, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils; Cephalopoda, pl. 64 **A**, fig. 1.
Palæontology of New York, vol. v, pt. 2, pl. 106; fig. 8; Suppl. (= vol. vii, 1888), pl. 126, fig. 2.
Hamilton group. Richmondville, N. Y.

J. Gebhard purchase.

Nautilus subliratus, Hall. 1876.

Illustrations of Devonian Fossils; Cephalopoda, expl. pl. 58, figs. **3, 4.**

Palæontology of New York, vol. v, pt. 2, pl. 57, figs **6, 7.**

Hamilton group. Earlville, N. Y.

Geological Survey collection.

Illustrations of Devonian Fossils; Cephalopoda, pl. 58, fig. **1.**

Palæontology of New York, vol. v, pt. 2, pl. 57, fig. **3.**

Hamilton group. Earlville, N. Y.

Geological Survey collection.

Illustrations of Devonian Fossils; Cephalopoda, pl. 58; fig. **2.**

Palæontology of New York, vol. v, pt. 2, pl. 57, fig. **4.**

Hamilton group. Earlville, N. Y.

Geological Survey collection.

Nautilus Hyatti, Hall. 1886.

* Fifth Annual Report of the New York State Geologist, Expl. pl. (126) 11, fig. **1.**

* Palæontology of New York, vol. v, pt. 2, Suppl. (=vol. vii, 1888), p. 37, pl. 126, fig. **1.**

Hamilton group. Cumberland, Md.

Nautilus acræus, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 417, pl. 110, figs. **3, 4, 5.**

Hamilton group. Near Bridgewater, N. Y.

Collected by F. B. Meek, R. P. Whitfield and C. Van Deloo, 1857.

Nautilus bucinum, Hall. 1876.

Illustrations of Devonian Fossils; Cephalopoda, pl. 60, fig. **4.**

Palæontology of New York, vol. v, pt. 2, pl. 60, fig. **4**; pl. 106, fig. **6.**

Hamilton group. Solsville, N. Y.

Geological Survey collection.

Palæontology of New York, vol. v, pt. 2, pl. 109, fig. 1.

Hamilton group. Canandaigua Lake, N. Y.

Collected by R. P. Whitfield and C. Van Deloo, 1862.

Palæontology of New York, vol. v, pt. 2, pl. 109, fig. 6.

Hamilton group. Delphi, N. Y.

Collected by H. H. Smith and C. Van Deloo, 1873.

Palæontology of New York, vol. v, pt. 2, pl. 107, figs. 2, 3.
Hamilton group. Pratt's Falls, N. Y.

Palæontology of New York, vol. v, pt. 2, pl. 106, fig. 7.
Hamilton group. Cazenovia, N. Y.
Palæontology of New York, vol. v, pt. 2, pl. 109, fig. 2.
Hamilton group. Cazenovia, N. Y.

Collected by James Hall, 1862.

Palæontology of New York, vol. v, pt. 2, pl. 106, figs. 4, 5.
Hamilton group, Cazenovia, N. Y.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 60, figs. **1, 2, 3.**
Palæontology of New York, vol. v, pt. 2, pl. 60, figs. **1, 2, 3.**
Goniatite limestone. Schoharie, N. Y.

J. Gebhard purchase.

Nautilus (*Discites*) *Marcellensis*, Vanuxem. 1842.

Geology of New York; Report on Third District, p. 146, fig. **2.**
Palæontology of New York, vol. v, pt. 2, pl. 109, fig. **10.**
Goniatite limestone. Manlius, N. Y.

Geological Survey collection.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 65, fig. 1.
Palæontology of New York, vol. v, pt. 2, pl. 65, fig. 1.
Goniatite limestone. Near Manlius, N. Y.

Palæontology of New York, vol v, pt. 2, pl. 109, figs. 9, 12.
Goniatite limestone. Schoharie, N. Y.

J. Gebhard purchase.

TROCHOCERAS, Hall. 1852.

Trochoceras Gebhardi, Hall, 1852.

Palæontology of New York, vol. ii, p. 335, pl. 77, fig. **2.**
Coralline limestone. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. 4, pl. 77 A, fig. **17.**
Coralline limestone. Schoharie, N. Y.

J. Gebhard purchase.

Trochoceras turbinatum, Hall. 1852.

Palæontology of New York, vol. ii, p. 336, pl. 77, fig. **1**.
Coralline limestone. Schoharie, N. Y.
J. Gebhard purchase.

Trochoceras Barrandii, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 398, pl. 111, fig. **10**.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 111, fig. **8**.
Schoharie grit. Clarksville, N. Y.

Palæontology of New York, vol. v, pt. 2, pl. 111, fig. **9**.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Trochoceras eugenium, Hall. 1861.

14th Rept. N. Y. State Cab. Nat. Hist., p. 108.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 59, fig. **9**.

Palæontology of New York, vol. v, pt. 2, pl. 59, fig. **11**.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 48, fig. 3.
Palæontology of New York, vol. v. pt. 2, pl. 58, fig. 3.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 48, fig. 4.
Palæontology of New York, vol. v, pt. 2, pl. 58, fig. 4.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Trochoceras Pandion, Hall. 1876.

Illustrations of Devonian Fossils; Cephalopoda, pl. 48, fig. **7**.
Palæontology of New York, vol. 5, pt. 2, pl. 58, fig. **7**.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Illustrations of Devonian Fossils; Cephalopoda, pl. 48, fig. **8**.
Schoharie grit. Schoharie, N. Y.
J. Gebhard purchase.

Illustrations of Devonian Fossils; Cephalopoda, pl. 48, fig. **9**.
Palæontology of New York, vol. v, pt. 2, pl. 58, fig. **9**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 111, fig. 3.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Trochoceras Biton, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 395, pl. 111, fig. **7**.
Schoharie grit. Near Clarksville, N. Y.

Collected by C. Van Deloo, 1862.

Trochoceras discoideum, Hall. 1861.

Descr. New Species Foss., p. 36.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 59, fig. **6**.
Palæontology of New York, vol. v, pt. 2, pl. 59, fig. **8**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Trochoceras expansum, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 402, pl. 111, fig. **5**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Trochoceras obliquatum, Hall. 1876.

Illus. Dev. Foss. Expl., pl. 48, fig. 5.

Palæontology of New York, vol. v, pt. 2, pl. 111, figs. 1, 2.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Trochoceras Clio, Hall. 1861.

14th Rept. N. Y. State Cab. Nat Hist., p. 108.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 59, fig. **4**.
Palæontology of New York, vol. v, pt. 2, pl. 59, fig. **1**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 59, figs. **1, 2**.
Palæontology of New York, vol. v, pt. 2, pl. 59, figs. **1, 2**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 59, fig. 4.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 59, fig. **7**.
Palæontology of New York, vol. v, pt. 2, pl. 59, fig. **9**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, pl. 111, fig. **6**.
Schoharie grit. Clarksville, N. Y.

Trochoceras? (*Gonioceras?*) *pandum*, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 403, pl. 111, figs. **4**.
Schoharie grit. Schoharie, N. Y.

J. Gebhard purchase.

Palæontology of New York, vol. v, pt. 2, Suppl. (= vol. vii, 1888), pl. 117, figs. 3, 4.
Schoharie grit. Knox, N. Y.

C. Van Deloo, 1862.

Palæontology of New York, vol. v, pt. 2, Suppl. (= vol. vii, 1888), pl. 117, fig. 5.
Schoharie grit. Near Clarksville, N. Y.

Collected by C. Van Deloo, 1862.

GONIATITES, De Haan. 1825.

Goniatites Vanuxemi, Hall. 1879.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 69, fig. 6.
Palæontology of New York, vol. v, pt. 2, pl. 69, fig. 6.
Goniatite limestone. Manlius, N. Y.

Geological Survey collection.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 69, figs. 3, 4.
Palæontology of New York, vol. v, pt. 2. Suppl. (vol. vii), pl. 127, figs. 5, 6.
Goniatite limestone. Manlius, N. Y.

Geological Survey collection.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 69, fig 5.
Palæontology of New York, vol. v, pt. 2, pl. 69, fig. 5.
Goniatite limestone. Manlius, N. Y.

Geological Survey collection.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 68, figure; Palæontology of New York, vol. v, pt. 2, pl. 68, figure.
Goniatite limestone. Fenner, N. Y.

L. Lincklaen, donor.

Palæontology of New York, vol. v, pt. 2, Suppl. (= vol. vii, 1888), pl. 127, fig. 4.
Goniatite limestone. Schoharie, N. Y.

J. Gebhard purchase.

Goniatities Vanuxemi, var. *nodiferus*, Hall. 1886.

Fifth Annual Report of the New York State Geologist. Expl. pl. 127 (12), fig. **7.**

Palæontology of New York, vol. v, pt. 2, Suppl. (= vol. vii, 1888), p. 39, pl. 127, fig. **7**.
Marcellus shales. Cox's Falls, near Cherry Valley, N. Y.

Collected by J. W. Hall, 1877.

Goniatites discoideus, Hall. 1860.

13th Rept. N. Y. State Cab. Nat. Hist., p. 97.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 71, fig. 1; Palæontology of New York, vol. v, pt. 2, pl. 71, fig. 1.
Tully limestone. Smith's ledge, Otisco, N. Y.

Geological Survey collection.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 71, figs. 8, 9; Palæontology of New York, vol. v, pt. 2, pl. 71, figs. 8, 9; pl. 74, fig. 4.
Goniatite limestone. Manlius, N. Y.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 71, fig. 4; Palæontology of New York, vol. v, pt. 2, pl. 71, fig. 4; pl. 74, fig. 3.
Goniatite limestone. Manlius, N. Y.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 71, figs. 5, 6; Palæontology of New York, vol. v, pt. 2, pl. 71, figs. 5, 6.
Goniatite limestone. Manlius, N. N.

Goniatites plebeiformis, Hall. 1879.

Palæontology of New York, vol. v, pt. 2, p. 44, pl. 110, fig. **3.**
Marcellus shales. Cherry Valley, N. Y.

Collected by J. W. Hall, 1877.

Palæontology of New York, vol. v, pt. 2, pl. 110, fig. **4.**
Marcellus shales. Cherry Valley, N. Y.
Collected by J. W. Hall, 1877.

Palæontology of New York, vol. v, pt. 2, pl. 110, fig. **5.**
Marcellus shales. Cherry Valley, N. Y.
Collected by J. W. Hall, 1877.

Palæontology of New York, vol. v, pt. 2, pl. 110, fig. **6.**
Marcellus shales. Cherry Valley, N. Y.
Collected by J. W. Hall, 1877.

Palæontology of New York, vol. v, pt. 2, pl. 110, fig. **7.**
Marcellus shales. Cherry Valley, N. Y.
Collected by J. W. Hall, 1877.

Palæontology of New York, vol. v, pt. 2, pl. 110, fig. **8.**
Marcellus shales. Cherry Valley, N. Y.
Collected by J. W. Hall, 1877.

Palæontology of New York, vol. v, pt. 2, pl. 110. fig. **9.**
Marcellus shales. Cherry Valley, N. Y.
Collected by J. W. Hall, 1877.

Goniatites unilobatus, Hall. 1874.

Descr. New Species Goniatitidæ, p. 1.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 71, figs. **15, 16;** Palæontology of New York, vol. v, pt. 2, p. 438, pl. 71, figs. **15, 16.**

Hamilton group. Norton's Landing, Cayuga Lake, N. Y.

Goniatites amplexus, Hall. 1886.

Fifth Annual Report of the New York State Geologist, Expl. pl. (127) 12, fig. **1.**

Palæontology of New York, vol. v, pt. 2. Suppl. (=vol. vii), p. 39, pl. 127, fig. **1.**

Tully limestone. Lodi Landing, Seneca Lake, N. Y.

Goniatites uniangularis, Conrad. 1842.

Jour. Acad. Nat. Sci. Phila. vol. 8, p. 268, pl. 16, fig. 4.

Palæontology of New York, vol. v, pt. 2, Suppl. (=vol. vii, 1888), pl. 127, fig. 10.

Hamilton group. Pratt's Falls, N. Y.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 72, figs. 6, 7.
Palæontology of New York, vol. v, pt. 2, pl. 72, figs. 6, 7.
Portage group. Mt. Morris, N. Y.
Geological Survey collection.

Goniatites complanatus, Hall, var. *perlatus*, Hall. 1876.

Discr. New species Goniatitidæ, p. 1.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 70, fig. **12.**
Palæontology of New York, vol. v, pt. 2, pl. 70, fig. **12.**
Portage group. Near Homer, N. Y.
Geological Survey collection.

Goniatites Patersoni, Hall. 1860.

Thirteenth Rept. N. Y. State Cab. Nat. Hist., p. 99.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 72, fig. 5;
Palæontology of New York, vol. v, pt. 2, pl. 72, fig. 5.
Portage group. Portageville, N. Y.
Geological Survey collection.

Goniatites sinuosus, Hall. 1843.

Geol. N. Y.; Rept. 4th Dist., p. 243, fig. 6.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 70, fig. 13;
Palæontology of New York, vol. v, pt. 2, pl. 70, fig. 13.
Lower Chemung group. Ithaca, N. Y.
Geological Survey collection.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 70, fig. 14;
Palæontology of New York, vol. v, pt. 2, pl. 70, fig. 14.
Lower Chemung group. Truxton, N. Y.
Geological Survey collection.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 70, fig. 15;
Palæontology of New York, vol. v, pt. 2, pl. 70, fig. 15; pl. 74, fig. 11.
Lower Chemung group. Ithaca, N. Y.
Collected by J. W. Hall and C. Van Deloo, 1866.

Goniatites Chemungensis, Vanuxem. 1842.

Geology of New York; Report on the Third Geological District, p. 182, fig. **1**; Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 60, fig **9**; Palæontology of New York, vol. v, pl. 69, fig. **9**; pl. **74**, fig. **6.**
Chemung group. Near Owego, N. Y.
Geological Survey collection.

Goniatites Chemungensis, var. *æquicostatus*, Hall. 1874.

Descr. New Species Goniatitidæ, p. 3.

Illustrations of Devonian Fossils, 1875; Cephalopoda, pl. 69, fig. **10.**
Palæontology of New York, vol. v, pt. 2, pl. 69, fig. **10.**
Chemung group. Western New York.

Goniatites simulator, Hall. 1874.

Descr. New Species Goniatitidæ, p. 2.

Illustrations of Devonian Fossils, 1876; Cephalopoda, pl. 69, figs. **1, 2.**
Palæontology of New York, vol. v, pt. 2, pl. 69, figs. **1, 2;** pl. 74, fig. **8.**
Chemung group. Near Ithaca, N. Y.

Goniatites peracutus, Hall. 1876.

Illustrations of Devonian Fossils, Cephalopoda, pl. 69, fig. **8;** Palæontology of New York, vol. v, pt. 2, pl. 69, fig. **8;** pl. 74. fig. **13.**
Chemung group. Cornell's quarry, Ithaca, N. Y.
Collected by J. W. Hall and C. Van Deloo, 1866.

Summary.

ANNELIDA.

Total types	1
Total figured specimens	33
Total figures	33

CEPHALOPODA.

Total types	205
Total figured specimens	408
Total figures	487
Casts of types	4

Notes Upon Two Boulders of a Very Basic Eruptive Rock from the West Shore of Canandaigua Lake; and their Contact Phenomena Upon the Trenton Limestone.

By Prof. B. K. EMERSON, Amherst College.

[Communicated for the report of the State Geologist.]

The rocks described below were sent to me by Prof. John M. Clarke with the following note:

"Specimens and sections marked:

"1 and 2. Boulder of Trenton limestone from southern part of town of Canandaigua, N. Y., on west shore of lake.

"1. Limestone at contact with dyke.

"2. Dyke.

"x. Fragments of limestone.

"3 and 4. Boulder of eruptive, including small masses of sandstone from same locality, about forty rods from other boulder.

"These are the only rocks of this character I have seen in the drift of western New York."

The specimens had been sawed and broad surfaces polished, and this greatly facilitated their study. Slides of an unusual size were also sent, showing abundantly all the different types present.

The specimen numbered 1 —"limestone at contact with dyke"— is a dull black, aphanitic, trap-like rock, effervescing slowly with acid and showing minute pyrite grains and pale green, distant porphyritic spots on the polished face.

The largest spots reach the size of a pin-head. With the pocket lens the thin sections show thickly and evenly disseminated elongate blades of red brown color, with irregular ends and black, shapeless ore grains and plates, and the porphyritic spots seem to be mainly marked by the absence of the brown blades and the greater amount and larger size of the black grains, and to be composed of interlaced, colorless and elongate plates.

When examined with the microscope the red brown blades seem to be goethite. They are wholly without pleochroism and, under the microscope, have the same red brown shade as the Lake Superior goethite, and also have the parallel extinction of the rhombic forms. They resemble in shape, size and distribution the actinolite described below from other contact products. The rounded black ore grains are, at least in part, magnetite, as the magnet abstracts fine grained ore from the powder. Dark grains of black ore are inclosed within the goethite blades.

The colorless fresh ground is made up of interlaced plagioclase plates which show few and interrupted twin lamellæ. They present both the albite and pericline systems of twinning, and are often marked by undulose extinction. The maximum angle of extinction is 18° on a side and the feldspar may be near labradorite. Crystals, where the broad, twinning bands extinguish uniformly with sharp border, adjoin those where the undulose extinction completely blurs the outlines of the separate bands, and this is in a wholly massive rock which shows not the slightest trace of strong crushing, or of any force acting upon it from without.

The clear spaces are mostly aggregates of feldspar plates like those in the general ground, with many rounded grains of black ore scattered in irregular masses, but with traces of octahedral form, or blades having exactly the same shape, size and distribution as the goethite blades, but being now black and made up of a close set or congeries of minute black grains. Here the goethite blades have probably been changed to magnetite. Some of the clear spaces are made up of a mottled network of indeterminate fibers, with a soft aggregate polarization, which suggests a fine grained muscovite growth. The whole rock is a very fresh and very curious goethite-magnetite-plagioclase contact rock.

Specimen No. 2, marked "Dyke," with which the above rock was in contact, is a black basic eruptive rock like that at Thetford, Vt. The phenocrysts of black basaltic hornblende, 2–4 mm. across, are as perfectly shaped, seen on the polished face, as those from Bohemia, and larger ones, 10–15 mm. across, appear in the fractured surface of the same rock. With a lens the large hornblendes at one end of the slide are seen to be large perfect crystals, and to pass, toward the other end, into more and more corroded forms, until at last only traces remain, while a nearly colorless to greenish pyroxene, faintly brown toward the border, appears with about the same size as the hornblendes, and increases in number of crystals as the hornblende disappears, and incloses many unoriented fragments of the latter. The pyroxene is a

sharp angled crystal, and in one of the greenish centers polarizes at an angle of 34° with c, and the brown border at 42°.

Rounded colorless spots full of round ore grains, seem to be minute inclosures of the contact rock described above. They give aggregate polarization.

The large hornblendes, under the microscope, are very fresh, and have a deeper colored border where they have been corroded. These remnants are often included, wholly or partly, in the large fresh pyroxenes, but without crystalline orientation. In one curious case a large pyroxene, cut at about right angles to the prism, has one quadrant of its surface replaced by the fragment of a hornblende crystal, whose outside faces very nearly continue the proper boundary of the pyroxene crystal, while its inside face, that is, the face by which it is grown together with the pyroxene, is a fracture. Its outside faces, moreover, have the deeper resorption color, while this is lacking on the inside face. There is an entire lack of orientation, the vertical axis of the hornblende about coinciding with one of the horizontal axes of the pyroxene. The pyroxenes are thus plainly later than the hornblendes, and a second, much smaller generation of pyroxenes occurs in well formed elongate crystals surrounded by a heavy border of black grains.

The rock shows distinctly an interstitial amorphous ground mass, full of minute, short, straight, brightly polarizing rods. These may probably be pyroxene, and a few larger but still minute rods, raveled at the ends, may also be of the same character. They do not show twin striation and have too bright polarization colors to be plagioclase. The ground is so full of the shapeless grains of black ore, that, in the thick slides studied, the presence of plagioclase could not be made certain. The rock is thus almost a pure pyroxenite. The magnetite scattered through the mass is surrounded by a broad border of deep red color where the glassy ground mass had dissolved the iron in part and become ferruginous. This is not the case in the colorless inclosures mentioned above.

Some portions of this ground mass polarize in broad irregular patches with bluish colors like nepheline, but these patches are not to be distinguished from the rest in ordinary light.

Specimen "X," marked "Fragments of Limestone," is a large piece of dark unaltered Trenton limestone,* with white crinoid stems, and the

* [NOTE.—This limestone, away from the contact surfaces with the eruptive, is exceedingly tough, and though traces of fossils are plainly evident, identifiable forms are to be seen only where the rock has weathered to a thin and very soft argillaceous crust. The following species will serve to determine the geological age of the rock: *Calymene senaria*, Conrad, *Strophomena rubtenta*, Conrad, *Plectambonites sericea*, Sowerby. J. M. CLARKE.]

rock remains sensibly unaltered and the white crinoid stems unchanged to within an inch of the large hornblende crystals of the eruptive rock. A narrow layer of hornstone forms the intermediate band by which they are firmly united into one mass.

Specimen No. 3, marked "Boulder of eruptive rock including small masses of sandstone," is a still more remarkable rock. It also closely resembles the rock from Thetford, Vt., and shows great splendent, black hornblendes above an inch in length, with rounded outlines from resorption in the magna. It includes many superficially rusted sandstone inclosures, but the eruptive rock is very fresh. The ferruginous character and the coarse grain of the inclosures suggest that they may have come from the Oneida sandstone. The slides were all cut from the vicinity of the different small inclosures which swarm in the rock, and show only few brown hornblendes. These are greatly corroded by the magma. One large greenish pyroxene appears having a very narrow pale brown border. Several small olivine crystals appear in the slide.

Fragments of a pistachio-green carbonate, a half-inch long, appear among the inclosures, and, as it is freshly and coarsely crystalline, seems to be a secondary formation. It gives slight effervescence with cold acid, abundant with hot acid, a strong reaction for iron, and is apparently siderite. It is peculiar in showing a strong dichroism, lemon green parallel to the horizontal, and colorless parallel to the vertical axis. In the slides which are very thick some places retain their green color almost unchanged through a complete revolution, and these show the negative uniaxial ring system with several rings as in calcite, and as the light vibrates thus parallel to the horizontal axes there would of course be no dichroism. In other sections which show by their cleavage that they are cut parallel to the vertical axis, the dichroism is as stated above.

In another large piece from the last boulder, one side is the fresh large grained eruptive rock with small sandstone inclosures, and this fresh eruptive rock graduates in two or three inches into an equally firm and fresh looking rock which contains, in a dark green ground-mass, scattered large rounded isolated hornblendes, pyroxenes and fragments of the eruptive rock, and many small inclosures of sandstone and limestone, and secondary grains of deep green calcite. The green ground-mass is, under the microscope, a complete felt of actinolite needles. It would be an actinolite schist except that it has not been made schistose by pressure. The matted actinolite needles show faint pleochroism, and extinguish at 26°–30°, and in many places project finely into the calcite-filled cavities.

The fragments of the original lava are little altered. The hornblendes are either not at all, or but slightly bleached at their border.

In one case a hornblende has changed to a matted mass of actinolite. The pyroxenes are not changed. Small olivines are changed to fibrous matted serpentine. In one case deep brown geniculate rutiles are perched upon the actinolite and enveloped in the calcite.

It is interesting to see this actinolite felt cementing minute fragments of the lava and separate crystals of the basaltic hornblende and pyroxene. The abundance of calcite favors the process and the lime feldspars and actinolite have crystallized abundantly under circumstances which permitted the simultaneous crystallization of calcite and left the amorphous ground mass and the primary constituents of the lava quite intact.

Several years ago I described some contact rocks and dyke rocks resembling these, from the border of a great dyke of elæolite-syenite in the north of New Jersey, and a comparison of these rocks led me to suspect the presence of nepheline in these specimens, but I could not find it with certainty.

Mr. J. F. Kemp has described* a remarkable erratic from Aurora, Cayuga Co., N. Y., which is of exactly the same character as the rock here described, except that it is not accompanied by contact forms.

It is there assigned to the nepheline-bearing dyke rocks free from olivine, to which the name *fourchite* has been given, although no nepheline has been found in the rock. Some of the slides examined by me would admit of this assignment. In others several olivine crystals occur in a single slide, and the rock would then be called *monchiquite*, or since both forms contain hornblende, they would be called hornblende fourchite or hornblende monchiquite, according to the same rather overloaded nomenclature.

Prof. Kemp surmises that his rock may have come from the Archæan areas to the north. From the present occurrence a nearer source of both erratics is probable.

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* American Journal of Science, Vol. XXIII, Chap. III, 1882 p 302.

The Devonian Section of Central New York Along the Unadilla River.*

By CHARLES S. PROSSER.

[Communicated for the report of the State Geologist.]

The Unadilla section of the New York middle and upper Devonian† is located about midway between the meridians of 75° and 75° 30′ W. Long. from Greenwich, or between 1° 30′ and 2° E. Long. from Washington.

The section commences in Paris township, Oneida county, and follows the Unadilla valley southward through portions of Madison, Chenango and Otsego counties to New Berlin, Chenango county. At this village the Unadilla valley is left and the hills which form the watershed between the Unadilla and Susquehanna rivers are crossed to Oneonta and Otego in Otsego county. The termination of the section is south of the Susquehanna river on the high hills of Delaware county.

The Corniferous limestone which gives a somewhat marked physical character to the region, so that its general easterly and westerly direction is readily followed, is made the geologic base of this general section. The rock is massive and not easily affected by weathering, a fact shown by the bold escarpments of the hills whose summits and slopes are often covered with angular fragments of the limestone.

Numerous articles have been written describing the effect of the Corniferous and other similar limestones upon the overlying soil. Some authors hold the opinion that the fertility of the soil is largely due to the underlying limestone; while another view is "that soils are so far removed from their parent rock, that the one upon which they

* The greater portion of this paper was originally presented to the Faculty of Cornell University as a thesis for the degree of M. S.

† In a paper on "The Classification of the Upper Devonian," by Dr H. S. Williams, this section received the number X on the chart of the "Meridional sections of the Upper Devonian deposits of New York, Pennsylvania and Ohio." Proc. Am. Assoc. Adv. Sci., vol. xxxiv, see page 225: also Fifth Ann. Rept. U. S. Geol. Survey, p. 52; and Smithsonian Ann. Rept., 1883, p. 79.

now repose can not give us much light or information of their nature or composition."* However all the hills in this region, especially the steep slopes and summits where the soil is only two or three feet in thickness, are more fertile when the Corniferous limestone is the underlying rock than those hills farther south where the soil is underlain by Hamilton shales and sandstones.

The "blue limestone" as it is locally designated is darker than in Western New York (see specimens from Batavia and Le Roy of the Genesee section †) and the exposures of the Unadilla section are probably darker in color than those farther east. Vanuxem said in his final report, referring to the Third Geological District of the State survey, "the color of the rock [Corniferous limestone] is more dark at the west than the east end of the district,"‡ while the Unadilla section is approximately half way between the eastern and western limits of that district. The difference in color might possibly be explained by a greater deposition of carbonaceous matter in this portion of the formation than in that farther east or west, which would correspond roughly to the greatest thickness of the overlying Marcellus shale. §

The first local station examined was Chapman's Quarry, No. 469A,‖ in Paris township, Oneida county, which is nearly one mile north of Babcock Hill and a little more than that distance southeast of Cassville. The rock is massive, weathering but slightly, not enough to injure its durability, and five feet out of an exposure of six feet is worked and used for building and flagging stones. The strata of massive stone are from two to ten inches in thickness, generally separated by shaly layers containing fossils. The fossils, which are mostly Brachiopods, fragments of Crustacea, segments of Crinoid stems, and few, if any Corals, are rare in the upper strata of massive stone, and near the bottom of the quarry appear to be confined to the shaly layers. Two layers of hornstone, each about 5½″ in thickness separated by 11″ of compact limestone are near the top of the quarry. In these layers of hornstone, fossils are quite common, especially *Atrypa reticularis*, Linné. When the rock is freshly broken there is a noticeably strong petroleum odor.

The complete fauna of No. 496A, is given below.

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* Emmons in Agri. N. Y., vol. i, p. 218; also see p. 176, and Geol. N. Y., Pt. IV, p. 170.

† Proc. Am Assoc. Adv. Sci., vol. xxxiv, p. 224.

‡ Geol. N. Y., Pt III, p. 140; also see Agri. N. Y., vol. i, p. 178.

§ Geol. N. Y., Pt. III, pp. 147–8; and Pt. IV, p. 179.

‖ The numbers of the stations have been assigned by the U. S. National Museum, where the material upon which this report is based will eventually be deposited.

Atrypa reticularis, Linné.*

Leptæna rhomboidalis, Wahlenberg.

Leptocœlia acutiplicata, Conrad.

Orthis lenticularis, Vanuxem.

Chonetes sp. Small forms not having the specific characters well defined.

Chonetes acutiradiata, Hall (?).

Smaller than the specimens figured in Pal. N. Y., vol. iv, pl. 20, fig. 5; but with the general proportion and markings of those specimens.

Spirifer raricosta, Conrad.

Stropheodonta nacrea, Hall.

Lingula sp.

Fragment of a *Trilobite*.

Segments of *Crinoid* stems.

Between Chapman's quarry and Babcock hill are several exposures one of which had formerly been worked for a quarry.

The last considerable outcrop noticed is No. 496 B, a few rods east of Babcock Hill postoffice. There is exposed 4½′ of massive stone and near the bottom are two hornstone layers separated by 11″ of limestone. Above the massive stone are alternating strata of thin limestones and shales, among which are two hornstone layers separated by a 6″ limestone. This quarry has not been worked for some years and the elevation agrees approximately with that of No. 496 A. The two most abundant fossils are the same as for △ 496 A:

Atrypa reticularis, Linné.

Leptæna rhomboidalis, Wahlenberg.

In addition to the fauna of 496 A, the following species were found in 496 B:

Rhynchonella Horsfordi, Hall (?).

Stropheodonta sp. A convex form with produced hinge line.

The exposures of Babcock Hill and vicinity have long been regarded as typical Corniferous limestone of Oneida county.

If the fauna of the Corniferous limestone at Le Roy, Batavia and other places in western New York be compared with that of the Unadilla section, the abundance of corals in the former and the absence of them in the latter will be noticed as the distinguishing feature. There are no large exposures south of Babcock Hill for a distance of several miles along the range of hills on the eastern side of the valley.

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*The species enumerated in the lists of fossils of this paper, are arranged approximately according to their relative abundance at each station; the one named first being the most abundant.

About one and one-half miles northeast of Bridgewater village, Oneida county, is a steep hill, No. 497A, which gives but a few unimportant exposures. The surface stone, which by its angularity indicates no great transportation, enables one to construct a rough section of the hill in connection with the few exposures *in situ*. Near the foot of the hill and in the valley are limestone boulders in which *Atrypa reticularis* Linné and *Leptæna rhomboidalis* Wahlenberg are common. These are evidently from the Corniferous limestone which underlies the valley and may extend some distance up the hill. Fragments of argillaceous black shale containing very few fossils are common over most of the hill.

In a little exposure of black argillaceous shale, No. 497A′, almost at the foot of the hill was found a single fair specimen of *Liorhynchus* which is probably a flattened *L. limitaris*, Vanuxem, although the form is similar to young specimens of *L. multicosta*, Hall. (See Pal. N. Y., vol. iv, pl. 56, fig. 26.)

In addition were found several fragments evidently of the same species, with a fragment of a *Conularia*. Farther up the hill among loose fragments are specimens very closely allied to *Liorhynchus limitaris*, Vanuxem.

Near the summit of the hill in iron-stained shales, No. 497A″, more arenaceous and coarse than those described above, which with reasonable certainty were not distant from similar shales *in situ*, were found:

Spirifer mucronatus, Conrad.

Liorhynchus, sp. Small specimens between *L. limitaris*, Vanuxem and *L. multicosta*, Hall.

Liorhynchus multicosta, Hall. A dorsal valve with seven plications on the fold.

Chonetes sp.

Nuculites triqueter, Conrad (?).

Crinoid stems.

Among the loose specimens from other parts of the hill are the following additional species:

Athyris spiriferoides, Eaton (?).

Chonetes setigera, Hall (?).

Conularia sp.

The section compiled from the above data seems to be as follows: The Corniferous limestone of Babcock Hill forms possibly the base of the hill, but does not extend far up its sides. The greater part of the hill is composed of Marcellus shales, while the summit is capped by Hamilton shales. Although all the fossils found in 497A[11] have been found in the Marcellus with one exception, yet the lithologic

similarity of these shales to those of typical Hamilton, farther south, apparently supports the last statement. Quite probably if there were opportunity for better study of the section, the upper shales would prove to be transitional from the typical Marcellus to typical Hamilton.

Nearly one mile southwest of West Winfield, Herkimer Co., on the north side of the highway from West Winfield to Bridgewater, Oneida Co., is △497B. A small brook has exposed some shales in addition to those on the hillside. Locally this station is known as the "coal mine," from the fact that some years ago a considerable excavation was made in the vain hope of finding coal, the search for which was confined to a stratum of Marcellus shale at the foot of the hill on the western bank of the brook, where it is massive when taken out, but upon weathering splits up finely. The shale is quite black, has a brownish-black streak and contains *Styliola fissurella*, Hall, in great abundance. Diligent search failed to reveal any trace of coal either in the rock or its joints. The lowest exposures of 497 B′, in the brook just above the highway, contain the following species:

Coleolus aciculum, Hall (?).

Lunulicardium fragile, Hall (?).

Goniatites sp.

The fossils are rare in these exposures and imperfectly preserved.

A little higher in the "coal mine" 497 B″, are:

Styliola fissurella, Hall. This species is very abundant. Plant stems, common.

Goniatites discoideus, Hall.

Coleolus aciculum, Hall (?).

An exposure of thin arenaceous shales near the summit of the hill, 497 B‴, one hundred feet higher than B′, contains a few fossils. The most common is a small *Liorhynchus*, probably *L. limitaris*, Vanuxem. There was also found a *Styliola* (?) and, rarely, fragments of other fossils.

The lower shales of △497 B are somewhat calcareous, thin layers of calcite frequently occurring in the joints of the rock, while those near the top of the hill are arenaceous. The hill is evidently composed of Marcellus shales, although the upper part might more properly be considered as transitional from the Marcellus to the Hamilton. This is the most southern typical exposure of Marcellus shale noticed in the Unadilla section.

△498 A is a section of Markham Mountain, a high hill on the eastern side of the Unadilla river, in Plainfield, Otsego Co. The "mountain" is

only a short distance southeast of Unadilla Forks and approximately 3.2 miles southwest of △497B. A circuitous roadway leads from the village to the top of the "mountain" and some distance up the hill, by the roadside, is the lowest exposure 498A'. The rocks are thin, arenaceous shales, breaking up very irregularly, and iron-stained when weathered. The lithologic appearance of these shales is similar to those of △497A[2]. The fauna is as follows:

Liorhynchus multicosta, Hall.

Numerous specimens of the typical Hamilton form, also smaller forms apparently similar to the specimen figured by Prof. Hall as "a young individual" of this species. (See Pal. N. Y. vol. iv., pl. 56, fig. 26.)

Amboccelia umbonata, Hall.

One specimen shows both concentric and radiating striæ, while four internal impressions of the dorsal valve have a median depression extending from the umbo to the front of the valve.

Chonetes sp. Small specimens (with one exception) imperfectly preserved; probably *C. setigera*, Hall or *C. lepida*, Hall.

Paracyclas lirata, Conrad.

Nuculites oblongatus, Conrad.

Nuculites triqueter, Conrad.

Orbiculoidea sp.

Several fragments which have not been identified with certainty.

A ledge on the western side of the "mountain" forms a bluff near the summit and this has been called 498A[2]. There are from 50′ — 75′ of arenaceous shales and sandstones. The strata at the base of the ledge are of considerable thickness and one compact sandstone stratum 8″ in thickness would apparently make a fair quarry stone. Weathering, however, indicates the presence of iron. The layers higher in the bluff are thin and irregular and in view of the large amount of "stripping" that the quarrymen would be obliged to do, it is not probable that a profitable quarry could be opened. The sandstones and arenaceous shales do not contain an abundant fauna, either in reference to numbers or species, as may be inferred from the following list:

Rhynchonella congregata, Conrad (?).

The specimens are mostly internal impressions, common in occasional layers of arenaceous shale. Unadilla Forks is one of the localities given by Prof. Hall for the above species.

Spirifer medialis, Hall (?).

Only imperfect specimens.

Spirifer granulifer, Hall.

In loose specimens of calcareous rock, which may be fragments from what Prof. Hall calls "calcareo-arenaceous bands*" were found numerous specimens of apparently typical *Rhynchonella congregata*, Conrad. In association with the preceding species are specimens of a smaller *Rhynchonella*, which may be the young of *R. congregata*, Conrad, but resembles closely *R. prolifica*, Hall. *Spirifer medialis*, Hall occurs with the *Rhynchonellas*. *Spirophyton velum*, Vanuxem was noticed in loose sandstone slabs.†

△ 498 B is an exposure in a brook on the western side of the Unadilla river, about one mile southwest of Unadilla forks in Brookfield, Madison county. The rocks are shales which contain more arenaceous than argillaceous material. Fossils are not abundant. The fauna is:

Chonetes coronata, Conrad.

Liorhynchus multicosta, Hall.

Paracyclas lirata, Conrad. Several of the specimens very much distorted by pressure.

Spirifer mucronatus, Conrad. Small specimens of evidently this species.

Palæoneilo constricta, Conrad.

Coral.

Athyris spiriferoides, Eaton.

Rhynchonella sp.——

Tropidoleptus carinatus, Conrad. (?)

Upon first examination this specimen was identified as *Chonetes mucronata*, Hall, but more careful study seems to confirm the above determination. Apparently no trace of cardinal spines is preserved, and near the margin the impression shows the presence of pustules. About ten of the central striæ bifurcate near the margin of the shell. The resemblance of *C. mucronata*, Hall, to the young of *T. carinatus*, Conrad was noticed by Prof. Hall.‡

Chonetes sp.

Pleurotomaria.

Fragments of some other species.

A short distance south of Lloydsville hamlet in Plainfield, Otsego co., and one+mile south of 498 A. is 498 D. There is an exposure of 20′ of shales in the bed and by the side of a small creek. These shales are not coarse but split up into irregular fragments. About 10′ from

* Pal. N. Y., vol. iv, p. 342.

† See Geol. Rep't 3d Dist. N. Y., pp. 176, 177: also 16th Ann. Rep't. N. Y. State Cab. Nat. Hist., pp. 80, 82.

‡ Pal. N. Y., vol. iv, p. 125.

the base is a coarser layer in which *Spirifer mucronatus*, Conrad, is abundant. The shales contain the following species:

Spirifer mucronatus, Conrad.
Liorhynchus multicosta, Hall.
Athyris spiriferoides, Eaton.
Ambocœlia umbonata, Conrad.
Orthis Vanuxemi, Hall (?).
Orthoceras. Fragments of large and small forms.
Nucula (?).
Grammysia.
Panenka retusa, Hall (?).
Nuculites oblongatus, Conrad.
Conularia undulata, Conrad (?).
Atrypa reticularis, Linné (?).

A small specimen, probably the young of the above species (see Pal. N. Y., vol. iv, pl. 53, Fig. 3).

About one mile south of 498 D, and east of Leonardsville is a ledge of arenaceous, coarse shales some 8′ in thickness. The exposure is on the hill-side east of the river and highway, and is called 498 E. Fossils are not common, all of the following species being rare:

Spirophyton velum, Vanuxem.
Segments of crinoid stems.
Rhynchonella Sappho, Hall (?).
Paracyclas lirata, Conrad (?).
Leptodesma Rogersi, Hall.

A half mile further south, a small creek affords another exposure of nearly 12′. South of the creek near the first cross-road leading eastward, is 498 F. The rock consists of coarse, arenaceous shale, very similar in lithologic appearance to 498 E, but contains more fossils. The altitude of these shales is higher than that of 498 E.

The fauna is as follows:

Spirifer mucronatus, Conrad.
Ambocœlia umbonata, Conrad.
Rhynchonella. Specimens too imperfect for specific identification.
Tropidoleptus carinatus, Conrad. Small specimen, but evidently young of this species.
Rhynchonella prolifica, Hall (?).
Paracyclas lirata, Conrad.
Grammysia.
Microdon (*Cypricardella*) *bellistriatus*, Conrad.

Bellerophon patulus, Hall (?).

Doubtfully referred to this species from the resemblance of the specimen to fig. 10, pl. 24, pt. ii, vol. v, Pal. N. Y.

Near the top of the hill, fully 100′ higher than the preceding section, is an exposure of arenaceous shale, 498 G. The shale, however, is more argillaceous and somewhat more fossiliferous than that of 498 F. The fossils identified are:

Rhynchonella Sappho, Hall.

Thoracic segments of a large *Trilobite*, probably *Homalonotus DeKayi*, Green.

Rhynchonella congregata, Conrad.

Spirifer sp.

Nucula Randalli, Hall.

498 H is about one mile south of Leonardsville, on the eastern side of the Unadilla river, and in Brookfield, Madison Co. These layers, commencing somewhat farther north than the village and extending more than a mile along the eastern side of the hill, are composed of coarse, arenaceous shales, which tend to pass into thin sandstones of some little thickness and uniformity. At the place particularly examined (498 H) there is an exposure of coarse shales and thin sandstones 20′ in thickness, similar in lithologic appearance to those of 498 E, F and G on the opposite side of the river, and also to 498 A^2, the upper exposure of Markham mountain at Unadilla Forks. The only abundant fossil in these coarse shales is *Grammysia alveata*, Conrad. The following fossils were collected:

Grammysia alveata, Conrad. Quite a large number of specimens from the coarse, arenaceous shales.

Rhynchonella congregata, Conrad (?).

Rhynchonella Sappho, Hall (?).

Spirifer mucronatus, Conrad.

Ambocœlia umbonata, Conrad.

Liopteria sp. Type of *L. Rafinesquii*, Hall, and *L. DeKayi*, Hall. (See Pal. N. Y., vol. v, pt. I, pl. 20, figs. 7 and 17.)

Several specimens belonging to the *Pectenidæ*, but not perfect enough to admit of certain identification.

Tropidoleptus carinatus, Conrad.

Spirophyton velum, Vanuxem.

A single specimen of *Crania* or *Orbiculoidea*.

On a provisional list a fragment of a *Trilobite*, probably *Homalonotus DeKayi*, Green, is mentioned but, upon a re-examination of the fauna the specimen has not been found.

One half-mile southwest of the sandstone cliffs forming 498 H are Button Falls in Button Creek. The cascade 50′ or 60′ in height is composed of two falls and is just below the highway leading from the "river-road" up the hill. The bluish argillaceous shales of this station, 498 I′, are irregular in fracture and upon the whole not very fossiliferous. In the cliff at the foot of the falls and also in the bed of the creek is a stratum which contains abundant fossils. *Liorhynchus multicosta*, Hall, is very abundant in this stratum, the shale in places being almost entirely composed of these shells, many of which are very much distorted. In the creek below both the first and second falls are "pot-holes" one of which is four feet in depth and two feet in diameter. The fauna so far as identified is as follows:

Liorhynchus multicosta, Hall.
Amboccelia umbonata, Conrad.
Nuculites triqueter, Conrad.
Nuculites oblongatus, Conrad.
Rhynchonella Sappho, Hall.
Spirifer medialis, Hall (?). Small forms.
Chonetes.
Nucula bellistriata, Conrad.
Homalonotus DeKayi, Green. Segments.
Phacops rana, Green.
Productella.
Tellinopsis subemarginata, Conrad.
Palœoneilo constricta, Conrad.
Grammysia.

Above the falls for one-quarter of a mile, the bed of the creek is composed of shale which has been worn very smooth by the water. Somewhat farther up the creek are ledges on the right hand or eastern side which have been called 498 I^2. The lithologic character of these upper shales is similar to those of 498 I^1. Fossils are not abundant except in the lower part of the bluff. The following species have been identified:

Amboccelia umbonata, Conrad.
Tentaculites.
Chonetes scitula, Hall.

The number of striæ (50 ±) and general proportions agree in the main with the figures of this species, with the exception of one specimen which is larger than any of the forms figured.

Phacops rana, Green.
Productella.
Nuculites oblongatus, Conrad.

Tropidoleptus carinatus, Conrad.

Orthoceras crotalum, Hall (?).

Grammysia.

Pholadella radiata, Conrad.

Chonetes (?) *mucronata*, Hall. Possibly *Tropidoleptus carinatus*, Conrad, but I am quite sure that on one side are the proximal ends of two spines.

Chonetes deflecta, Hall (?). This specimen may be *C. mucronata*, Hall, but it is considerably larger than the figured specimens of that species, and apparently agrees well with the figures of *C. deflecta*, Hall. However, Prof. Hall writes that *C. deflecta*, Hall, may be, perhaps, only another phase of *C. mucronata*, Hall.*

Goniatites. Simply a fragment.

Ptilodictya (*Stictopora*). sp. Fragment.

Chonetes. Apparently young of *C. coronata*, Conrad. (See Pal. N. Y., vol. iv, pl. 21, Fig. 10 a, b.)

Two + miles down the river from 498 I, and three-fourths of a mile from West Edmeston is an exposure of shales in Ordway creek, which has been numbered 498 K. The most abundant fossil is *Nyassa arguta*, Hall. The fauna in full is given below:

Nyassa arguta, Hall.

Orthis. Specimens very imperfectly preserved in a thin sandstone stratum.

Nuculites triqueter, Conrad.

Modiella pygmaea, Conrad.

Palæoneilo constricta, Conrad.

Rhynchonella. Small specimens and specific characters not well defined.

Chonetes.

Athyris spiriferoides, Eaton.

Spirifer.

Pterinea flabella, Conrad.

Liopteria DeKayi, Hall (?).

Homalonotus DeKayi, Green.

In the thin sandstone, as is also

Spirophyton velum, Vanuxem.

Quite extensive collection of fossils was made at different places in Brookfield, Madison county, and the following lists will give a good idea of the middle Hamilton fauna of Central New York. 499 A, on the summit of Beaver hill, one and one-half miles east of Brookfield,

* Pal. N. Y., vol. v, p. 126.

is the highest outcrop east of Beaver creek, the aneroid barometer reporting it as 540′ above the Unadilla river at Leonardsville, or 370′ above the village of Brookfield. The rock is a gray, arenaceous shale, weathering to a brownish color, and is laminated, some of the layers being smooth and of regular thickness, so that it is apparently a good flagging stone. The fossils are rare, only two species being found:

Stropheodonta perplana, Conrad.

Chonetes coronata, Conrad (?).

No. 499 B. A line of ledges on Beaver hill, south-east of Brookfield. The rock consists of arenaceous shales, in which fossils are not very common, except in a thin layer near the bottom of the exposure.

Fauna of 499 B.

Rhynchonella congregata, Conrad (?).

Stropheodonta perplana, Conrad.

Spirifer mucronatus, Conrad.

Spirifer granulifer, Hall.

Vitulina pustulosa, Hall.

Terebratula sp.

Paracyclas lirata, Conrad.

Pterinea flabellum, Conrad.

No. 499 C. Exposure of shales by side of highway, a short distance west of Brookfield. The rocks are fissile, black, argillaceous shales, which upon weathering split up into very small fragments. The shales are quite fossiliferous, containing mostly Lamellibranch shells; but a thin layer contains large numbers of *Liorhynchus multicosta*, Hall.

Fauna of No. 499 C.

Liorhynchus multicosta, Hall.

Amboccelia umbonata, Conrad.

Chonetes coronata, Conrad.

Rhynchonella prolifica, Hall (?).

Rhynchonella congregata, Con. (?).

Nuculites oblongatus, Conrad.

Nuculites triqueter, Con. (?).

Nucula lirata, Con. (?).

Pleurotomaria, sp.

Goniatites, sp.

No. 499 D. Ledges along the banks of a branch of West Creek, near M. Kenyon's farm, one mile west of Brookfield. At the base is a fissile argillaceous shale, which decomposes readily upon exposure to the air and is highly fossiliferous, containing many Lamellibranchs. A short distance farther up the creek, and ten feet higher are arena-

ceous shales, considerably iron stained, containing principally *Chonetes*. Above these shales are the fine argillaceous ones again.

Fauna of No. 499 D.

Ambocœlia umbonata, Conrad.
Rhynchonella prolifica, Hall.
Chonetes, sp.
Productella, sp.
Nuculites oblongatus, Conrad.
Nuculites triqueter, Con. (?).
Nucula bellistriata Con. (?).
Grammysia sp.
Orthoceras sp.
Goniatites sp.
Dumb-bell fucoid.

No. 499 F. Exposures on West Creek, southwest of Brookfield. At the base of the section (F') ten feet of coarse argillaceous shales, which on weathering split up into rather large pieces. The fossils are not so abundant as in the finer shales, but the species are mainly the larger forms. The list for No. 499 F' is:

Nucleospira concinna, Hall.
Ambocœlia umbonata, Conrad.
Athyris spiriferoides, Eaton.
Liorhynchus multicosta, Hall (?).
Spirifer medialis, Hall (?).
Orthis cf. Penelope, Hall.
Rhynchonella prolifica, Hall.
Actinopteria decussata, Hall.
Nuculites Nyssa, Hall.
Modiomorpha complanata, Hall.
Pterinea flabellum, Conrad.
Nyassa arguta, Hall (?).
Grammysia sp.
Platyceras sp.
Pleurotomaria sp.
Orthoceras sp.

For 100' the bank is covered by drift and soil, then there is an exposure of coarse arenaceous shales and thin sandstones which has been worked to some extent as a quarry. *Tropidoleptus carinatus*, Con. is very abundant and the complete fauna of No. 499 F'' is as follows:

Tropidoleptus carinatus, Conrad.
Nucleospira concinna, Hall.

Spirifer mucronatus, Conrad.
Orbiculoidea Seneca, Hall (?).
Stropheodonta perplana, Conrad.
Amboccelia umbonata, Conrad.
Terebratula Lincklæni, Hall.
Rhynchonella Sappho, Hall.
Orthis Vanuxemi, Hall.
Productella sp.
Chonetes sp.
Cypricardinia indenta, Conrad.
Paracyclas lirata, Conrad.

Farther up West creek than No. 499.F are ledges near the side of the creek. At the base are rather fine arenaceous shales (No. 499.E[1]), which are fossiliferous.

Fauna of No. 499. E[1].
Amboccelia umbonata, Conrad.
Vitulina pustulosa, Hall.
Spirifer mucronatus, Conrad.
Spirifer medialis, Hall.
Rhynchonella prolifica, Hall.
Rhynchonella Sappho, Hall, or *congregata* Con.
Terebratula Lincklæni Hall (?).
Chonetes sp.
Productella sp.
Orbiculoidea sp.
Paracyclas lirata, Conrad.
Palæoneilo emarginata. Conrad.
Nucula Randalli, Hall.
Nyassa arguta, Hall.
Grammysia sp.
Orthoceras sp.

A little higher an exposure of coarse arenaceous shales, 6′ 9″ in thickness, containing fossils characteristic of the coarse Hamilton shales.

Fauna of No. 499, E[2].
Stropheodonta perplana, Conrad.
Rhynchonella prolifica, Hall.
Nucleospira concinna, Hall.
Spirifer medialis, Hall.
Amboccelia umbonata, Conrad.
Terebratula Lincklæni, Hall (?).

Productella sp.
Paracyclas lirata, Conrad.
Pterinea flabellum, Conrad.
Actinopteria decussata, Hall.
Grammysia magna, Hall.
Schizodus ellipticus, Hall (?).
Glyptodesma erectum, Conrad.
Grammysia arcuata, Conrad.
Nyassa arguta, Hall.
Aviculopecten sp.

Near the above locality on a branch of the West creek are coarse, arenaceous shales, forming a ledge 20′ high. Fossils are not very common, and the upper layer is a smooth stratum four inches thick, which would make a thin flagstone.

Fauna of No. 499 E^3.
Spirifer granulifer, Hall.
Rhynchonella Sappho, Hall.
Rhynchonella prolifica, Hall (?).
Stropheodonta perplana, Conrad.
Tropidoleptus carinatus, Conrad.
Paracyclas lirata, Conrad.
Palæoneilo emarginata Con. (?).
Pterinea flabellum, Conrad.

No. 499, G. Exposures of coarse, arenaceous shales on Quaker Hill, about four miles southwest of Brookfield. Near the top of the hill are very coarse shales to thin sandstones, in which a small quarry was opened.

Fossils are not abundant and the list is as follows :

Spirifer medialis, Hall. In one layer a large number of specimens which apparently belong to this species. There are a few which have a sinus in the fold and a small fold in the bottom of the sinus.
Spirifer mucronatus, Conrad.
Tropidoleptus carinatus, Conrad.
Amboccelia umbonata, Conrad.
Chonetes, sp.
Modiomorpha subalata, Conrad.

500, A^1. Exposures by highway about one and one-half miles from North Brookfield on road from North Brookfield to Brookfield. At this locality there is a small quarry where building stone has been quarried. At the base is five feet of massive, bluish gray sandstone which shows no tendency to split into regular layers. Above the sand-

stone is five feet, principally of coarse arenaceous shales, but with more argillaceous shales on top.

Fauna of No. 500, A^1.

Rhynchonella Sappho, Hall.
Rhynchonella congregata, Con. (?).
Chonetes coronata, Conrad.
Lingula ligea, Hall (?).
Orbiculoidea grandis, Van. (?).
Spirifer medialis, Hall.
Spirifer mucronatus, Hall.
Modiomorpha complanata, Hall.
Grammysia bisulcata, Con. (?).
Goniophora hamiltonensis, Hall.
Cimitaria recurva, Conrad.
Tentaculites attenuatus, Hall.
Orthoceras constrictum, Con. (?).
Crinoid stems.

Southeast of 500 A^1 and 200′ higher on the hillside is an exposure of 10′ of coarse, arenaceous shales. Fauna of 500 A^2.

Spirifer medialis, Hall.
Rhynchonella contracta, Hall (?).
Rhynchonella Sappho, Hall (?).
Crinoid stems.

500 C.— Gorton Lake, three and one-half miles from Brookfield, occupies a depression near the top of the high hills in that part of the township. At a short distance from the lake, in the outlet is a cascade giving an exposure of eighty feet, consisting mostly of soft, dark argillaceous shales. In the bed of the creek, C^2, just above the falls, is a stratum rich in fossils, both as to number of specimens and species. *Spirifer mucronatus*, Conrad, is very common; *Nucleospira concinna*, Hall, quite abundant with nicely preserved specimens; and *Paracyclas lirata*, Conrad, also quite common. In a stratum of the thin black shales, C^1, about half way down the ravine the following species occur:

Spirifer mucronatus, Conrad, very common.
Amboccelia umbonata, Conrad.
Nucleospira concinna, Hall, abundant.
Orbiculoidea Doria, Hall.
Orthoceras subulatum, Hall, more common than in any other locality of this region.
Phacops rana, Green, several good specimens.

Paracyclas lirata, Conrad, very abundant, well preserved with considerable variation in the form of the shell.

The complete list of fossils is as follows:

1. *Stropheodonta perplana*, Conrad.
2. *Athyris spiriferoides*, Eaton.
3. *Spirifer medialis*, Hall.
4. *Spirifer mucronatus*, Conrad.
5. *Spirifer granulifer*, Hall.
6. *Rhynchonella prolifica*, Hall.
7. *Orbiculoida Doria*, H[illegible].
8. *Ambocœlia umbonata*, Conrad.
9. *Nucleospira concinna*, Hall.
10. *Vitulina pustulosa*, Hall.
11. *Chonetes coronata*, Conrad (?).
12. *Orthoceras constrictum*, Conrad.
13. *Orthoceras subulatum*, Hall.
14. *Orthoceras nuntium*, Hall.
15. *Paracyclas lirata*, Conrad.
16. *Grammysia bisulcata*, Conrad (?).
17. *Actinopteria decussata*, Hall.
18. *Pterinea flabellum*, Conrad.
19. *Phacops rana*, Green.
20. *Homalonotus DeKayi*, Green.
21. *Favosites Hamiltoniæ*, Hall.
22. *Palæoneilo constricta*, Conrad.
23. *Nuculites oblongatus*, Conrad.
24. *Tellinopsis subemarginata*, Conrad.
25. *Nucula Randalli*, Hall.
26. *Nyassa arguta*, Hall (?).
27. *Nuculites triqueter*, Conrad.
28. *Nucula bellistriata* Con. (?).

No. 500. E. An exposure of shales in the bed of a small brook e short distance north of North Brookfield. The lower layers (E^1) ara medium coarse arenaceous shales in which *Ambocœlia umbonata* Conrad, occurs abundantly in thin layers, but other fossils are rare. The fauna of No. 500. E^1 is as follows:

Ambocœlia umbonata, Conrad.
Productella Shumardiana, Hall.
Productella truncata, Hall.
Rhynchonella prolifica, Hall (?).
Paracyclas lirata, Conrad.

Nucula Randalli, Hall.

A little farther up the brook the shales are finer, more argillaceous and contain a larger number of fossils.

The fauna of No. 500. E^2 is:

Amboccelia umbonata, Conrad:
Tropidoleptus carinatus, Conrad.
Rhynchonella polifica, Hall.
Spirifer mucronatus, Conrad.
Grammysia, sp.
Homalonotus DeKayi, Green.

501. C. Exposures along the outlet of the "Lake Swamp" in the southwestern part of Brookfield. At the foot of the falls are 6′ of argillaceous shales (C^1) in which *Tropidoleptus carinatus*, Conrad, occurs. Above these argillaceous shales are 24′ of coarse arenaceous shales, which form the falls. Fossils are not common, but the following species were obtained in No. 501 C^2:

Tropidoleptus carinatus, Conrad.
Spirifer medialis, Hall.
Amboccelia umbonata, Conrad.
Chonetes coronata, Conrad.
Chonetes deflecta, Hall (?).
Palæoneilo constricta, Conrad.
Nuculites oblongatus, Conrad.
Grammysia bisulcata, Con. (?).
Homalonotus DeKayi, Green.
Dalmanites sp., border of pygidium.

From the arenaceous shales above the falls (C^3) the following species were obtained:

Amboccelia umbonata, Conrad.
Chonetes scitula, Hall.
Spirifer mucronatus, Conrad.
Chonetes coronata, Conrad.
Chonetes deflecta, Hall (?).
(?) *Cryptonella planirostra*, Hall.
Nucula bellistriata, Conrad.
Palæoneilo constricta, Conrad.
Nuculites oblongatus, Conrad.
Nuculites triqueter, Con. (?).
Grammysia sp.
Pleurotomaria capillaria, Con. (?).
Loxonema delphicola, Hall (?).

Phacops rana, Green.

No. 501 D^1. Exposures on lot No. 6, near the top of one of the highest hills in southwestern Brookfield. The rocks consist of coarse arenaceous shales, alternating with more argillaceous shales which contain many specimens of *Chonetes coronata*, Conrad. The following species were collected at this locality:

Chonetes coronata, Conrad.

Tropidoleptus carinatus, Conrad.

Spirifer medialis, Hall.

Spirifer mucronatus, Conrad.

Chonetes coronata, Con. var. syrtalis Con.

Amboccelia umbonata, Conrad.

Rhynchonella congregata, Conrad (?).

A half mile further north by the roadside and near the top of the hill are arenaceous shales, not so coarse as those of D^1, which contain an abundance of fossils in some layers. The following species were collected at No. 501 D^2.

Tropidoleptus carinatus, Conrad.

Spirifer medialis, Hall, one specimen with a groove in the mesial fold.

Spirifer granulifer, Hall (?).

501 A. Exposures on Beaver Creek, near the boundary between Brookfield and Columbus. A small quarry has been opened in this rock, but not worked to any extent. The rock consists entirely of an argillaceous, fine grained sandstone which weathers to a yellowish-brown, in some cases breaking up into quite regular blocks, which can be used for rough building purposes. The rock is evenly bedded in layers from ½-inch to a foot or more in thickness. Some of the strata are very fossiliferous, a single stratum of the lower layers, A^1, containing the following species in great abundance:

Spirifer medialis, Hall.

Rhynchonella prolifica, Hall.

Streptorhynchus Chemungensis, Conrad.

In the layers fifteen feet higher A^2, several species were found which were not noticed in the lower, as:

Tropidoleptus carinatus, Conrad.

Spirifer granulifer, Hall.

Amboccelia umbonata, Conrad.

On a single slab six inches square are good specimens of *Tropidoleptus carinatus*, Conrad; *Spirifer medialis*, Hall; *Rhynchonella prolifica*, Hall, and *Streptorhynchus Chemungensis*, Conrad

The complete fauna of 501 A^1 and A^2 is:

Tropidoleptus carinatus, Conrad.
Streptorhynchus Chemungensis, Conrad.
Spirifer medialis, Hall.
Spirifer granulifer, Hall.
Spirifer mucronatus, Hall (?).
Rhynchonella prolifica, Hall.
Ambocœlia umbonata, Conrad.
Tentaculites alternatus, Hall.
Cypricardinia indenta, Conrad (?).
Actinopteria decussata, Hall.
Crinoid stems.

Station 502 A is one and one-half miles south of West Edmeston in Edmeston, Otsego county. A small run, Burdick's, cuts through the soil and to some extent into the rocks, affording exposures well up the hill. The lowest exposure, 502 A^1, is only a few rods east of Mr. Burdick's farm house. The rock is a rather coarse arenaceous shale in which fossils are common. The following species have been identified:

Spirifera medialis, Hall. The specimens are all small.
Actinopteria Boydi, Conrad (?).
Leptodesma Rogersi, Hall (?).
Stropheodonta perplana, Conrad.
Goniatites.
Spirifer mucronatus, Conrad.
Rhynchonella.
Nyassa arguta, Hall.
Orthoceras.

A short distance up the creek is a cliff of shales, 502 A^2, slightly more argillaceous than A^1. Fossils are not common, all the following species being rare:

Rhynchonella; small forms.
Spirifera medialis, Hall (?).
Lunulicardium fragile, Hall (?).
Tellinopsis subemarginata, Conrad.
A specimen belonging to the *Pectinidæ.*

502 A^3 are thin arenaceous shales, quite regularly bedded. Some of the layers contain black clay pebbles. Fossils are more abundant than in A^2. The fauna is:

Rhynchonella.

The specimens are common, but they are all small. It is possible that all of them may be the young of *R. congregata*, Conrad. Several

of the specimens appear to have the proportions of small *R. eximia*, Hall (see Pal. N. Y., vol. iv, pl. 55, fig. 1). Others are nearer young *R. prolifica*, Hall, having about sixteen plications, and are without a marked sinus and fold, a fact noticed by Prof. Hall in young specimens of this species (see Pal. N. Y., vol. iv, p. 343).

Liorhynchus multicosta, Hall.

Segments of *crinoid* stems.

Ambocœlia umbonata, Conrad.

Palæoneilo emarginata, Conrad.

Tropidoleptus carinatus, Conrad.

In the upper part of the creek are cliffs of 20′ and falls, which have been called 502 A[4]. The shales are arenaceous, some layers quite regular, and micaceous; generally with fossils, but these are for the most part small forms. The following species from this exposure have been identified:

Rhynchonella congregata, Conrad (?).

A majority of the specimens appear to be nearer *R. congregata*, Conrad, than any other figured forms. Some small specimens which are probably the young of the above resemble small *R. prolifica*, Hall. It is extremely difficult to determine with precision the specific identity of many of the *Rhynchonellas* in the eastern Hamilton.

Spirifer medialis, Hall.

Small specimens of the above species.

Nucula bellistriata, Conrad.

Ambocœlia umbonata, Conrad.

Leptodesma Rogersi, Hall (?).

The wing of the specimens does not appear to be as mucronate as in the figured forms of this species. In this respect they agree more closely with the short forms of the Chemung, *L. sociale*, Hall, particularly with a specimen from Broome county. (See Pal. N. Y., vol. v, pt. I, I, pl. 21, fig. 33.) However, *L. Rogersi*, Hall, is given as abundant in the Hamilton group, and specimens are mentioned from Norwich, Chenango county, and Leonardsville, Madison county. (See Pal. N. Y., vol. V, pt. I, I, p. 177.)

Chonetes scitula, Hall.

Productella.

Liorhynchus multicosta, Hall.

Paracyclas lirata, Conrad.

Goniatites.

Tentaculites.

Goniophora carinata, Conrad.

Tropidoleptus carinatus, Conrad.

Grammysia.

Nuculites oblongatus, Conrad.

Palæoneilo emarginata, Conrad.

Orthoceras. Only a fragment.

Lunulicardium fragile, Hall.

Plant stems.

"Dumb-bell" fucoid or concretion.

Three + miles south of 502 A, or one mile north of south Edmeston is station 502 B. The outcrop consists of arenaceous moderately coarse shales in the bed and side of a small stream. Some of the strata are very fossiliferous, containing a large number of *Rhynchonellas* and *Spirifer Tullius*, Hall. The complete fauna is given below:

Rhynchonella.

The specimens are numerous and there are apparently forms which are clearly *R. Sappho*, Hall; others that agree with *R. congregata*, Conrad; while there are intermediate forms among the above species.

Spirifer Tullius, Hall.

Fenestella.

Spirifer granulifer, Hall.

The external impression of one specimen showing the fine interrupted striæ upon the strong plications; a character not often seen, according to Prof. Hall. (See Pal. N. Y., vol. iv, p. 224.)

Nuculites triqueter, Conrad.

Pterinea flabella, Conrad.

Tropidoleptus carinatus, Conrad.

Glyptodesma erectum, Conrad.

Nuculites oblongatus, Conrad.

Stropheodonta demissa, Conrad (?). Imperfect specimen.

Chonetes lepida, Hall (?).

Sphenotus solenoides, Hall.

The posterior portion of the specimen is well marked by the vascular lines and the anterior end is long: two characters which Prof. Hall says distinguish this species. (See Pal N. Y., vol. v, pt. i, ii, p. 399.)

Liopteria Rafinesquii, Hall (?).

The specimen is not perfect but apparently similar to a form from Leonardsville, N. Y., referred to the above species by Prof. Hall. (See Pal. N. Y., vol. v, pt. i, i, pl. 88, fig. 28.)

Spirifer mucronatus, Conrad.

Palæoneilo emarginata, Conrad.

Phacops rana, Green.

Grammysia.

Pterinopecten (?).

Three-fourths of a mile to the south almost directly east of South Edmeston, near the top of the high hill, is an exposure of coarse arenaceous shales called 502 C. This outcrop is considerably higher in actual elevation than the one just described. The fauna is as follows:

Spirifer granulifer, Hall. This species with the following one is abundant in this exposure.

Tropidoleptus carinatus, Conrad.

Stropheodonta perplana, Conrad.

Schizodus appressus, Conrad.

Palæoneilo emarginata, Conrad.

Crinoid stems.

Modiomorpha mytiloides, Conrad.

Glyptodesma erectum, Conrad (?).

Spirophyton velum, Vanuxem.

Phthonia sectifrons, Conrad.

Bellerophon.

Two specimens belonging to the *Pectinidæ*, but generic characters very imperfectly preserved.

On the same hillside not far from the station just described, southeast of South Edmeston and just north of a small brook, is a series of ledges. The lithologic characters are the same as for 502 C. The lower ledges have been called 502 D^1 and the species named below have been identified.

Chonetes coronata, Conrad.

There are specimens beside those which are clearly *C. coronata*, Conrad, corresponding closely to those figured by Prof. Hall, as the young of this species. (See Pal. N. Y., vol. iv, pl. 21, fig. 10 a, b). The internal impressions of the small forms are pitted in the same manner as the larger specimens.

Tropidoleptus carinatus, Conrad.

Crinoid segments,

Chonetes scitula, Hall.

Spirifer medialis, Hall (?).

These are small specimens which may be *S. Tullius*, Hall, instead of the above.

Productella dumosa, Hall (?).

Ambocœlia umbonata, Conrad.

Spirifer fimbriatus, Conrad.

Nucula bellistriata, Conrad.

Palæoneilo muta, Hall.

This specimen referred to is probably a variety of this species; the lamellose concentric striæ are coarser and the posterior extremity narrower than in the specimens figured.

Pleurotomaria capillaria, Conrad.

Coleolus tenuicinctus, Hall.

The higher exposures were called 502 D^2, and the following species were obtained:

Spirifer granulifer, Hall.

Tropidoleptus carinatus, Conrad.

Rhynchonella.

Small form of *R. congregata*, Conrad, or *R. prolifica*, Hall.

Spirifer medialis, Hall (?). Imperfect specimens.

Homalonotus DeKayi, Green. Segments only.

Pleurotomaria capillaria, Conrad.

Parts of *Crinoid* stems.

Liopteria DeKayi, Hall (?).

Modiomorpha concentrica, Conrad (?). Only a fragment.

The above fauna shows that 502 D^2 is a continuation of 502 C; *Spirifer granulifer*, Hall, and *Tropidoleptus carinatus*, Conrad, being very abundant in both stations.

Three miles south of station 502 D a series of cliffs were examined on the eastern bank of the Unadilla river. This station 503 A is in the northwestern corner of Pittsfield township opposite the upper river bridge and one mile northeast of New Berlin village, Chenango county.

Below the highway just at the river's edge is a bluish-gray sandstone 30″ in thickness, with coarse arenaceous shales above. The only fossil found here, 503 A^1, was a single large perfect specimen of *Chonetes coronata*, Conrad.

Just above the highway are moderately thin arenaceous shales cleaving with some regularity, containing very few fossils. Those found in these shales 503 A^2 are so fragmentary that a specific identification is difficult. The most common forms are *Grammysia*, and several fragmentary specimens agree quite closely with *G. bisulcata*, Conrad. Also several imperfect specimens of *Chonetes* were found.

Then comes a 10″ bluish-gray sandstone, 503 A^3, without any fossils so far as noticed, and above the sandstone rather thin arenaceous shales, 503 A^4, in which fossils are common. The fauna of 503 A^4 is given below:

Chonetes scitula, Hall.

This species is very abundant in these shales.

Tropidoleptus carinatus, Conrad.
Leptodesma Rogersi, Hall (?).
Palæonelio constricta, Conrad.
Prothyris lanceolata, Hall.
Spirifer Tullius, Hall (?).
Nucula lirata, Conrad.
Spirifer. Imperfect specimens resembling *S. mucronatus*, Conrad.
Nuculites triqueter, Conrad.
Goniatites.

A specimen belonging to the *Pectinidæ*, but in too imperfect a condition to admit of further identification.

Above A^4 is 20′ that is covered by and soil, then are ledges of shales and thin sandstones or very coarse shales. The lower shales, 503 A^5, are the coarser, consisting of arenaceous, blocky shales some of which are quite fossiliferous. The upper shales of the cliff are thin and arenaceous, somewhat evenly bedded and similar to those of 503 A^4. Fossils are common and in places abundant in both A^5 and A^6.

From the lower shales and the debris at the foot of the cliff, the following species were obtained:

Chonetes coronata, Conrad.
Amboccelia umbonata, Conrad.
Tropidoleptus carinatus, Conrad.
Nuculites oblongatus, Conrad.
Segments of *Crinoid* stems.
Spirifer Tullius, Hall.
Spirifer fimbriatus, Conrad.
Plant stems.
Spirifer grandifer, Hall (?).
Streptorhynchus Chemungensis, Conrad.
Nucleospira concinna, Hall.
Palæoneilo emarginata, Conrad.
Grammysia.
Leda diversa, Hall.
Nuculites triqueter, Conrad.
Schizodus. Only a portion of the specimen.
Chonetes mucronata, Hall.

From 503A^6, in which the fossils are more abundant than in A^5, the species named below have been identified:

Chonetes scitula, Hall.
Tropidoleptus carinatus, Conrad.
These two species are very common.

Ambocœlia umbonata, Conrad.
Nuculites oblongatus, Conrad.
Spirifer. Small specimens, part of them resembling *S. Tullius*, Hall, and the others *S. mucronatus*, Conrad.
Terebratula Lincklœni, Hall (?).
Palœoneilo constricta, Conrad.
Nuculites triqueter, Conrad.
Chonetes coronata, Conrad.
Pholadella radiata, Conrad.
Nucula bellistriata, Conrad.
Nucula lirata, Conrad.
Orthonota undulata, Conrad.
Leptodesma Rogersi, Hall.
Coleolus tennicinctus, Hall.
Spirifer fimbriatus, Conrad (?). Internal impression and considerably worn so that the characters are not clear.

Three miles southeast of 503 A, by the highway between the villages of New Berlin and Morris, are a series of outcrops, which have been called 503 B. These ledges begin near the foot of the long hill, the first a half mile or more beyond Fink's sawmill. The rock consists of rather coarse, blue, argillaceous shales, weathering greenish, alternating with thin, fine-grained sandstones, and all iron-stained after weathering. Fossils are extremely rare, none being found in the exposures which were hastily examined.

A mile farther up the hill from 503 B, north of the highway and just above a small creek, is an old quarry, not worked at present. This exposure, 503 C, is considerably higher than 503 B. The quarry stone is a blue, fine-grained sandstone, weathering to a brown, showing the presence of considerable iron. Thin sandstones and argillaceous shales, similar to those of 503 B, lie above the massive stone which forms the lowest exposures in the quarry. The only fossils found in the quarry were fragments of plant stems in a poor sandstone of the upper part. In the soil just above the rock were large, flat angular stones containing numerous fossils. These slabs had been probably carried but little distance from their place of occurrence. The fossils are mostly Spirifers and Rhynchonellas, but weathering and other causes have nearly obliterated the finer characters. *Chonetes* and fragments of Lamellibranch shells were also noticed.

503 D is a small exposure by the roadside at almost the summit of the hill, and one-fourth of a mile from the quarry. These shales are

bluish, mostly arenaceous, but some are argillaceous in composition. Fossils are common, the fauna being as follows:

Rhynchonella congregata, Conrad.

Part of the specimens are clearly of this species, while others have the more angular plications of *R. Sappho*, Hall; but Prof. Hall says: "The surface plications appear to be more angular in specimens from the arenaceous beds; and the casts of the interior of some specimens which I have referred to this species present distinctly angular plications." *

All of the above specimens with angular plications are from arenaceous shale.

Spirifer mucronatus, Conrad.

Chonetes.

Small forms which have about the same number of striæ as *C. lepida*, Hall, while in general proportions they are closely allied to *C. setigera*, Hall.

Chonetes scitula, Hall.

Liorhynchus multicosta, Hall.

Actinopteria Boydi, Conrad (?).

The specimens are hardly as wide in proportion to their height as most of the figured forms of the above species.

Spirifer sp. Large form with sinus and fold striated by fine plications.

Leptodesma.

Paracyclas lirata, Conrad.

One mile from 503 D, on the eastern slope of the hill, and lower is another little cliff by the roadside, 503 E. In a coarse arenaceous blue shale were found:

Spirifer mucronatus, Conrad.

Chonetes lepida, Hall (?).

Liorhynchus multicosta, Hall.

Rhychonella congregata, Conrad.

Productella.

In the above shale the fossils are common. A few feet lower is a blue thin-bedded, fine-grained sandstone quite similar to the quarry stone of 503 C.

Two and one-fourth miles from 503 E, just across the township line in the northern part of Morris county and one and one-half miles north-east of Morris village is an outcrop

* Pal. N. Y., vol. iv, p. 342.

of coarse arenaceous shales much iron-stained after weathering. This ledge is called 504 A, and in lithologic character resembles 503 E, although lower in actual elevation. The lower part of the exposure contains numerous fossils, the fauna being given below:

Spirifer mucronatus, Conrad.
Tropidoleptus carinatus, Conrad.
Paracyclas lirata, Conrad.
Rhynchonella congregata, Conrad (?).
Chonetes.
Spirifer. Fragment of a large one.
Orbiculoidea (?).
Modiomorpha.

Several specimens belonging to the *Aviculidæ*, but so imperfectly preserved that their identification is difficult. In a brook not far from 504 A, but considerably lower, is a cliff of 15′, 504 B, just below a sawmill. The rocks are coarse, blue arenaceous shales alternating with thin, blue sandstones which weather to a brown. No fossils were found, and the general appearance of this outcrop is similar to those of stations 503 B and C, up the lower two-thirds of the long Pittsfield hill.

One mile east of Morris village, near the highway leading from Morris to West Laurens, is 504 C. This exposure is three miles from 504 B, in a small stream flowing into Butternut creek from the southeast, and not very far up the hill. The lower layers in the creek are blue, arenaceous shales with a 14″ sandstone for the top. A little farther up the creek a quarry has been opened, and 5′ out of the 10′ exposed is quarry stone. The good stone is a blue sandstone which weathers to a brown and is used for building stone. A single imperfect specimen of a large *Spirifer* was found in the sandstone.

Up the hill from 504 C, the soil covers the rocks deeply, affording but small exposures. Two miles from 504 C and about one-half mile west of West Laurens, in the creek, is a small outcrop of blue arenaceous shale and thin sandstone called station 505 A. No fossils were found.

One half-mile southwest of West Laurens station 505 B, in a little run is an exposure of argillaceous shale somewhat regularly bedded, which weathers to a greenish tint. A few fossils were found. Several imperfect specimens of a small *Grammysia* and a single *Palæoneilo*, which is either *P. constricta*, Conrad, or *P. maxima*, Conrad. This is the last exposure of fossiliferous shales noticed before the red and gray shales and sandstones of the Oneonta group are reached.

A little higher than 505 B, capping the top of that hill and forming all the high land between Butternut creek and the Susquehanna river are red shales and sandstones alternating with gray shales and sandstones.

At Oneonta, in the Susquehanna river valley, is an excellent opportunity to study the transition from the fossiliferous rocks up into the barren reds and grays of the Oneonta sandstone formation. A short distance west of the village is the Anthony White quarry, which exposes 15′ of bluish sandstone separated by shaly layers into three strata.

Fauna of No. 507 B[1].

1. *Spirifer mesastrialis*, Hall (a).*
   A good many specimens show fine striæ very distinctly, and also irregular perforations in the shell substance, which are probably the borings of some parasite.
2. *Spirifer mucronatus*, Conrad (rr).
   A single ventral valve, with quite long mucronate extremities, seventeen plications on each side, and a distinct fold in the bottom of the sinus.
3. *Chonetes deflecta*, Hall (aa).
   About 26 striæ, cardinal angles flattened and smooth, quite gibbous.
4. *Rhynchonella Stephani*, Hall (c).
5. *Spirifer zigzac*, Hall (?) (rr).
   Impression of dorsal valve showing about six plications, with mesial depression in the fold.
6. *Rhynchonella Sappho*, Hall (rr).
7. *Tropidoleptus carinatus*, Conrad (rr).
8. *Nucula bellistriata*, Con. var. (a).
   The specimens are all smaller than those figured in the Palæontology of New York; but they have the fine striæ and general form of this species.
9. *Palæoneilo maxima*, Con. (c).
10. *Microdon* (*Cypricardella*) *bellistriatus*, Con. (r).
    The striæ are finer than those of the typical Hamilton specimens, but similar to those from Ithaca and Port Crane, Broome county, New York.
11. *Goniophora carinata*, Conrad (rr).
12. *Nyassa arguta*, Hall (r).

*a = abundant. c = common. r = rare. aa = very abundant. cc = very common. rr = very rare.

13. *Paracyclas lirata*, Conrad (c).
14. *Glyptodesma erectum* (rr).
15. *Tellinopsis subemarginata*, Con. (rr).
16. *Nuculites oblongatus*, Con. (rr).
17. *Modiomorpha concentrica*, Con. (rr).
18. *Grammysia magna*, Hall (rr).
19. *Grammysia bisulcata*, Con. (rr).
20. *Cimitaria recurva*, Con. (?) (rr).
21. *Nuculites triqueter*, Con.
22. *Microdon* (*Cypricardella*) *gregarius*, Hall.
23. *Leptodesma Rogersi*, Hall.
24. *Liopteria De Kayi*, Hall.
25. *Orthonota undulata*, Conrad.
26. *Microdon* (*Cypricardella*) *complanatus*, Hall.
27. *Coleolus tenuicinctus*, Hall (?) (a).
28. *Tentaculites attenuatus*, Hall var. (rr).

The specimens have the irregular transverse striae of the above species, but the size of *T. bellulus*, Hall.

29. *Pleurotomaria subemarginata*, Con. (aa).
30. *Homalonotus De Kayi*, Green (rr).
31. *Lepidodendron Gaspianum*, D'n (rr).

The rocks from which the above fauna came belong in Conrad's Oneonta group (not Vanuxem's Oneonta sandstone, which is above, forming the upper part of the hill), and were correlated quite accurately by Vanuxem, who stated that he supposed them to belong to the Ithaca group.*

In the western part of the village is a small creek and along its banks are exposures of this same zone. The lowest shales in the creek (507 F^1) contain the following species:

1. *Spirifer mesastrialis*, Hall (c).
2. *Chonetes deflecta*, Hall (?) (rr).
3. *Rhynchonella Stephani*, Hall (r).
4. *Nucula bellistriata*, Con. var. (c).
5. *Grammysia bisulcata*, Con. (rr).

Farther up the creek along the old raceway the following species were obtained:

1. *Spirifer mesastrialis*, Hall (r).
2. *Chonetes deflecta*, Hall (a).

* Geol. N. Y., pt. iii, p. 192. The clause reads: "The base of which [hill] is composed of rocks which I have supposed to belong to the Ithaca group."

3. *Rhynchonella* sp., part of the specimens are like *R. Stephani*, Hall, but there are small ones similar to the small forms of *R. eximia*, Hall.
4. *Microdon* (*Cypricardella*) *bellistriatus*, Con. (rr). The Ithaca form.
5. *Paracyclas lirata*, Con. (r).
6. *Nuculites oblongatus*, Con. (rr).
7. *Nucula bellistriata*, Con. var. (rr).
8. *Palæoneilo maxima*, Con. (rr).
9. *Tellinopsis subemarginata*, Con. (rr).
10. *Goniophora carinata*, Con. (rr).

Near Otego, eight miles down the Susquehanna river from Oneonta, the highest beds of the fossiliferous zone below the Oneonta sandstone are exposed and the following species were obtained:

1. *Nuculites oblongatus*, Con.
2. *Modiomorpha concentrica*, Con.
3. *Paracyclas lirata*, Con.
4. *Prothyris lanceolata*, Hall.
5. *Rhynchonella eximia*, Hall.
6. *Spirifer mesastrialis*, Hall.
7. *Spirifera mesacostalis*, Hall (?)
8. *Palæoneilo muta*, Hall.
9. *Nuculites cuneiformis*, Con.
10. *Microdon* (*Cypricardella*) *tenuistriatus*, Hall.
11. *Tropidoleptus carinatus*, Con.
12. *Coleolus aciculum*, Hall.
13. *Productella speciosa*, Hall, small variety.

At Schenevus, fifteen miles up the river from Oneonta, in the bluish shales near the foot of the high hill south of the village the following species were collected:

1. *Spirifer Tullius*, Hall.
2. *Microdon* (*Cypricardella*) *bellistriata*, Con.
3. *Modiella pygmæa*, Con,
4. *Tropidoleptus carinatus*, Con,
5. *Nuculites oblongatus*, Con. var.
6. *Phacops rana*, Green.
7. *Orthoceras calamen*, Hall.
8. *Rhodea pinnata*, Dn.
9. *Spirifer mucronatus*, Con.
10. *Grammysia subarcuata*, Hall.

11. *Chonetes coronata*, Con.
12. *Palæoneilo emarginata*, Con. (?).
13. *Nucula corbuliformis*, Hall (?).

The stratigraphic results of this study may be summarized in the following manner:

The Unadilla section commences in Corniferous limestone at Paris Hill, and the last exposures of the limestone are seen just east of Babcock Hill P. O. station, 496 B.

The high hill north-east of Bridgewater, station 497 A, is composed principally of Marcellus shales, with transitional shales forming the summit of the hill. A statement similar to the above may be made in regard to the low hill, 497 B, south-west of West Winfield, which is the most southern exposure of typical Marcellus shale.

At Unadilla Forks undoubted Hamilton shales and sandstones are found on Markham mountain. From the last station to 583 A in the northeastern part of Pittsfield, near New Berlin village, there is an alternation of coarse or fine shales with thin sandstones, all containing characteristic eastern Hamilton faunas. The fossils are not so abundant either in number of species or specimens as in the Cayuga section of the Hamilton. The rock is also much more arenaceous in the Unadilla section, very little of the shale being so fine or argillaceous as that of Cayuga lake. The encrinal limestone of the Hamilton, the Tully limestone and the Genesee shale were not seen, although Vanuxem mentioned Genesee shale at New Berlin.*

The fossiliferous outcrops in the river valley at New Berlin were regarded by the State Geologist of that district as the easternmost Hamilton exposure; the higher rocks being considered by him as the equivalent of the Portage and Ithaca groups.†

Succeeding the New Berlin fauna, station 503 A, there is a considerable thickness of blue shales and sandstones which are almost non-fossiliferous. In places the sandstone attains a thickness and regularity of bedding sufficient for quarrying. These shales and sandstones form all the long Pittsfield hill, except its summit or include stations 503 B and C, and probably 504 B and C of Morris township. This zone is regarded by the writer as the eastern continuation of the Sherburne sandstones and shales of the Annual Report.‡

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* Geol. N. Y. Pt. iii, p. 292.

† *Ibid*, p. 292.

‡ N. Y. Ann. Geol. Rep't, 1840, p. 381; Geol. N. Y. Pt. iii, pp. 170-2 and 292-3. Since this thesis was written I have published articles confirming this correlation. See Proc. Am. Assoc. Adv. Sci. vol. xxxvi, p. 210; also Am. Jour. Sci. vol. xlvi, p. 212.

Above the barren measures is a zone containing abundant fossils, which has been called the "*Paracyclas lirata*" stage of the middle Devonian fauna as traced above the horizon of the Genesee shale.*

Stations 503 D. and E. and 504 A. are in this zone, but it is much better exposed in the Susquehanna river valley near Oneonta. This zone is evidently the Oneonta group of Conrad,† while Vanuxem regarded it as belonging to the Ithaca group.‡

Later writers regard all of these upper shales and sandstones, to the grays and reds above, as forming the closing part of the Hamilton group,§ or at least as containing "modified stages of the Hamilton fauna.‖

Following the "*Paracyclas lirata* stage" are the red and gray sandstones and shales of Vanuxem's Oneonta or Montrose group.¶ This group or stage of rocks forms all of the high land between Butternut creek and Otego river; between Otego river and the Susquehanna river and the high hills south of the Susquehanna river.

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* Proc. Am. Assoc. Adv. Sci., vol. xxxiv, p. 225; also chart.

† N. Y. Ann. Geol. Rept., 1841, pp. 31, 50 and 53.

‡ Geol. N. Y., Pt. III, p. 192.

§ Science, vol i, p. 290 (Dec. 11, 1880); Pal. N. Y., vol. v, Pts. I, II, pp. 517-518.

‖ Proc. Am. Assoc. Adv. Sci., vol. xxxiv, pp. 225, 233-234, and chart.

¶ N. Y. Ann. Geol. Rept., 1840, p. 381. See also Proc. Am. Assoc. Adv. Sci., vol. xxxiv, pp. 225, 226, 233, 234, and chart.